GE
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Programmable Control Products

VersaPoint* I/O System

Motor Starter Modules

User's Manual GFK-2134

March 2010

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In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

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Chapter 1 VersaPoint Motor Starter Modules

This manual contains the instructions and reference information needed to install and use a VersaPoint Motor Starter module. There are three module versions:

- Motor Starter Direct, 1.5KW/400VAC Module (IC220STR001)
- Motor Starter Direct, 3.7KW/400VAC Module (IC220STR002)
- Motor Starter Reversing, 1.5KW/400VAC Module (IC220STR003)

This manual also describes optional equipment that can be used with a Motor Starter Module for local motor control, brake operation, and thermal protection of the motor.

Chapter 1: VersaPoint Motor Starter Modules, describes each module and lists its technical specifications. This chapter also gives an overview of optional equipment, and a list of ordering information for the Motor Starter Modules and optional equipment.

Chapter 2: Installation Instructions, This chapter provides specific installation information for the VersaPoint Motor Starter Modules.

Chapter 3: Data Exchanged by the Module and the System Host, describes the data formats used to configure, control, and monitor a Motor Starter Module.

Chapter 4: Local Motor Control, explains how to use Manual Mode for optional local control of the motor. This is usually done with a Motor Starter Pendent, which is also described in this chapter.

Chapter 5: Motor Starter Brake Modules, describes the use of an optional Motor Starter Brake Module.

Chapter 6: Thermistor Module for Motor Protection, describes the use of an optional Thermistor Module for thermal protection of motors with built-in thermistors.

Additional Documentation Needed

For additional installation instructions and communications information, you will also need the *Network Interface User's Manual* for your system.

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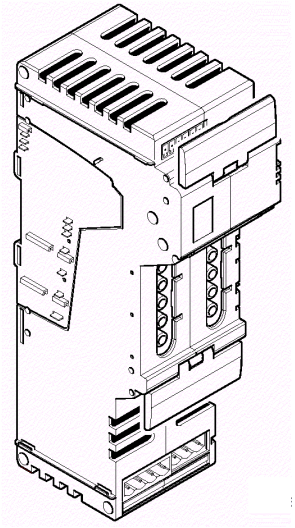
VersaPoint Motor Starter Modules



VersaPoint Motor Starter modules provide switching protection and monitoring of three-phase asynchronous motors. These modules are installed in the 24V area of a VersaPoint I/O Station.

Features of all VersaPoint Motor Starter Modules

- Integrated electronic motor protection according to IEC 60947-4:1990
- System control of the motor through the module's output data
- Optional local motor control
- Connection for optional external passive brake module
- Safe isolation between line voltage and 24V supply voltage according to EN 50178:1997
- Diagnostic and status indicators
- Motor current monitoring and integrated protection

Features of Motor Starter Direct, 1.5KW, 400VAC (IC220STR001)

- Nominal voltage is 400VAC
- Nominal Motor current is configurable from 0.2 Amps to 3.6 Amps
- This module must NOT be used for a reversing application

Features of Motor Starter Direct, 3.7KW, 400VAC (IC220STR002)

- Nominal voltage is 400VAC or 500VAC
- Nominal Motor current is configurable from 0.2 Amps to 8.0 Amps
- Two IC220STR002 modules can be used to control two motors that are set up for a reversing application.

Features of Motor Starter, Reversing, 1.5KW, 400VAC (IC220STR003)

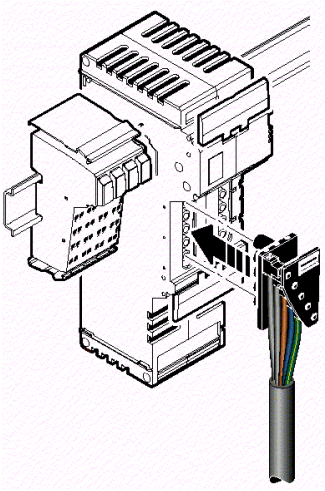
- Nominal voltage is 400VAC
- Nominal Motor current is configurable from 0.2 Amps to 3.6 Amps
- Controls motors with two directions of rotation.

Additional Equipment for Motor Starter Applications

The additional equipment described below can be used in a Motor Starter Module installation.

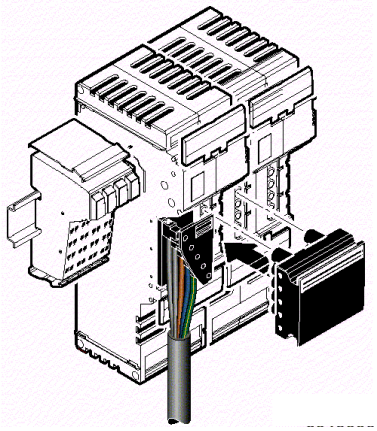
Motor Starter Power Connector

A Motor Starter Power Connector (IC220ACC103) can be used to connect the power source for the motor to the Motor Starter module:



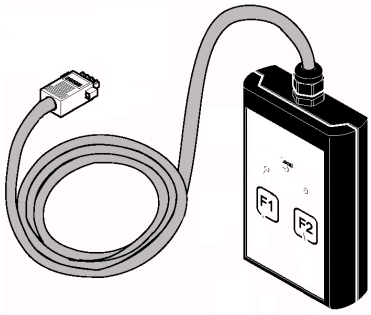
Motor Starter Power Bridge

A Motor Starter Power Bridge (IC220ACC104) can be used to connect a second Motor Starter module to the first. The Motor Starter Bridge passes power from the first Motor Starter module to the second.



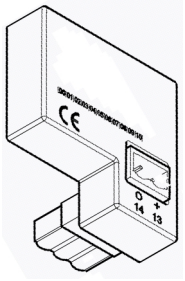
Motor Starter Pendent

An optional Motor Starter Pendent (IC220ACC102) can be connected to a Motor Starter Module and used to turn the motor on or off locally. When use of a Motor Starter Pendent is enabled, inputs from the Pendent override control commands from the system host. See chapter 4 for information about using a Motor Starter Pendent.



Motor Starter Brake Module

The optional Motor Starter Brake module is a passive electronic brake switch that can interface a brake to a Motor Starter module.



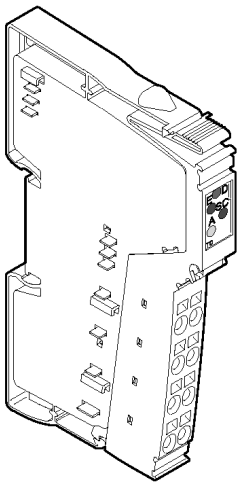
Two VersaPoint Motor Starter Brake modules are available: IC220ACC100 and IC220ACC101. See chapter 5 for more information about using Motor Starter Brake modules.

Motor Starter Brake Module Features

- Electronic brake switch (solid-state switch)
- Nominal voltage ranges:
  IC220ACC100: from 12VDC to 400VDC, 20VAC to 400VAC
  IC220ACC101: from 5VDC to 31VDC
- Protection against polarity reversal

Thermistor Module

Motors having integrated thermistors can be thermally-protected by wiring an optional VersaPoint Thermistor module (IC220MDD850) to the motor.



With the Thermistor Module's input connected to the motor thermistor, the module can check for:

- Operating range (resistance between 50 Ohms and 2.25k Ohms)
- Tripping range (resistance of 4k Ohms or more)
- Short-circuit (resistance of 50 Ohms or less)
- Motor temperature below the tripping temperature (generates warning)

If an error is detected, the Thermistor Module can turn off the motor either directly or indirectly.

- Direct control: the Thermistor Module's switching output turns off the 24V segment power to the Motor Starter Module, which will shut off the motor.
- Indirect control: the module reports the error condition to the system host, which can then turn off the motor by sending a command to the Motor Starter Module.

See chapter 6 for more information about using a Thermistor Module in a Motor Starter Module application.

1

Overview of Motor Starter Module Operation

Control and configuration of a Motor Starter Module are commanded by the system host.

Configuring the Nominal Motor Current

By default, the nominal motor current is set to 0.2 Amp. At startup or following a reset, the system host can change the nominal motor current to higher value as appropriate for the motor. For details of configuring the nominal motor current, see chapter 3.

Controlling the Motor and Optional Brake

During system operation, the system host controls the operation of the motor. The host also controls reset of the Motor Starter Module after an error has caused a shutdown.

If an optional Motor Starter Brake Module and brake are connected to the Motor Starter Module, the brake is also controlled by the system host. By default, brake control occurs automatically when the motor is switched on and off. However, the system host can also switch the brake independently of the motor operation. See chapter 3 for more information.

Optional Local Control

Connecting a Motor Starter Pendent or similar switching device to the Motor Starter Module's enable and motor control inputs automatically enables local control of the motor. Local control can also be set up by connecting only the motor control inputs and enabling Manual mode from the system host. See chapter 4 for information.

Diagnostics

The Motor Starter Module automatically monitors the current level of the motor. If the actual current level exceeds the nominal or configured current level, or if the current falls below 0.1A for module IC220STR001 or 0.16A for module IC220STR002, the module shuts down the motor. The module's ERR LED lights and it sends a diagnostic message to the system host.

The module also generates an error message if:

- The control signal for the module is NOT present, but the measured motor current is greater than the minimum current.
- The control signal for the module is present, but the motor current is below the permissible minimum current for that module type. For module IC220STR002, minimum current monitoring can be disabled as described in chapter 3.

General Specifications for Motor Starter Modules

Specifications for all three Motor Starter Modules are given below. Additional specifications for each module type are listed on the following pages.

Specifications for the VersaPoint Motor Starter Pendent, Motor Starter Brake Module and Thermistor Module are listed in their individual chapters.

Programming Data for All Motor Starter Modules	
ID code	BF hex (191 decimal)
Length code	81 hex (129 decimal)
Process data length	8 bits
Input data length	1 byte
Output data length	1 byte
Parameter channel (PCP)	0 bytes
Register length	1 byte

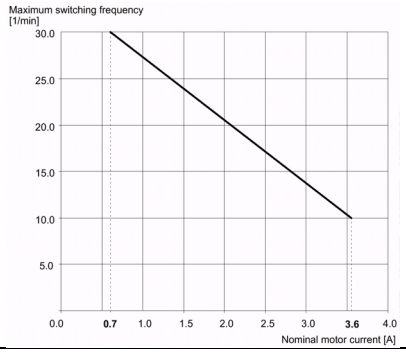
General Data for All Motor Starter Modules	
Housing dimensions (width x height x depth)	63mm x 224mm x 109mm (2.48in x 8.82in x 4.29in)
Ambient temperature (operation)	-25°C to +55°C (-13°F to +131°F)
Ambient temperature (storage/transport)	-25°C to +85°C (-13°F to +185°F)
Humidity	75% on average; 85% occasionally
Degree of protection	IP 20 according to IEC 60529
Class of protection	Class 1 according to VDE 0106, IEC 60536
Line protection of the voltage feeder	20A maximum
Required mounting position	Panel mounting on horizontal DIN rail mounting as shown in installation instructions
Mounting distances	At least 50mm (2 in) of space is required above and below the module, to assure adequate module ventilation.

Conformance With EMC Directive 89/336/EEC		
Noise Immunity Test According to EN 50082-2		
Electrostatic discharge (ESD)	EN 61000-4-2 IEC 61000-4-2	6kV contact discharge, Criterion B 8kV air discharge , Criterion B
Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	Criterion A Field strength: 3V/m
Fast transients (burst)	EN 61000-4-4 IEC 61000-4-4	Criterion B Supply lines: 2kV Signal/data lines: 2kV
Surge voltage	EN 61000-4-5 IEC 61000-4-5	Criterion B DC supply lines: 0.5kV/0.5kV (symmetrical/asymmetrical) Criterion B AC supply lines: 2kV / 4kV (symmetrical/asymmetrical)
Conducted interference	EN 61000-4-6 IEC 61000-4-6	Criterion A Test voltage 10 V
Noise Emission Test According to EN 50081-2		
Noise emission of housing	EN 55011	Class A
Do not operate the Motor Starter Module close to strong or medium-range electromagnetic fields. Portable radio transmission systems with transmission power above 2 Watts at a distance of 2 meters or less or the use of strong radio transmitters and ISM devices close to the Motor Starter Module may adversely effect its operation.		

Electrical Isolation for All Motor Starter Modules	
Safe isolation between line and SELV according to EN 50178:1998 For module IC220STR002: Up to a line voltage of 519VAC +0%: safe isolation Up to a line voltage of 600VAC +0%: basic insulation	
Supply voltage U_S / 400V level	1.2kVAC, 50 Hz, 1 min
Supply voltage U_S / brake switch	1.2kVAC, 50 Hz, 1 min
Supply voltage U_L / 400V level	1.2kVAC, 50 Hz, 1 min
Supply voltage U_L / brake switch	1.2kVAC, 50 Hz, 1 min
Remote bus / 400V level	1.2kVAC, 50 Hz, 1 min
Remote bus / brake switch	1.2kVAC, 50 Hz, 1 min

Mechanical Capability for All Motor Starter Modules	
Shock test according to IEC 60068-2-27; EN 60068-2-27	10g, Criterion 1
Vibration (operation) according to IEC 60068-2-6; EN 60068-2-6	
IC220STR001, IC220STR003: IC220STR002:	2g, Criterion 1 1g, Criterion 1

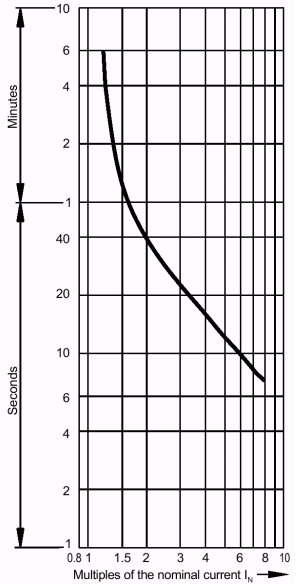
Specifications for Motor Starter Module IC220STR001

Motor Starter Module IC220STR001	
Switches	Electronic hybrid switches, two-phase switching. Connection and disconnection is carried out using thyristors that are jumpered by relays in the conductive state.
Operating voltage (conductor voltage)	187VAC to 440VAC ±0% minimum
Power frequency	50Hz or 60Hz
Nominal current range	0.2A to 3.6A
Minimum current	100mA. Minimum current of 0.1A per phase must be maintained in the operating state. Otherwise, module generates error message 10 "Power level cannot be controlled".
Power	1.5kW for AC 3 operation (4-position synchronous motor)
Usage category	According to AC 3
Switching frequency	30 switching operations per minute, maximum, depending on the nominal motor current and ambient temperature. Chart shows maximum switching frequencies at ambient temperatures of 25C (77F) and 55C (131F). 
Switch-on time	1 second minimum
Switch-off time	1 second minimum
Phase angle	cos φ = >0.3
Motor starting time	0.5s maximum
Internal Protection	Fuse 6.3 x 32 10 AT in the switched phases. Internal fuses are not user-replaceable. Do not attempt to repair the module. If the fuses blow the module MUST BE REPLACED!
Control voltage for the Motor Starter Module	24V segment voltage (when the segment voltage is switched off, the Motor Starter Module cannot be switched on and the motor is off.
WARNING: When the segment voltage is switched off, the motor is not disconnected.	
WARNING: If thermal damage occurs to the module, it may not be able to switch off the motor. It is important to provide an external switch so that the motor can be turned off in case the Motor Starter module is damaged.	

Power Consumption for Module IC220STR001	
Communications power U_L	7.5V
Current consumption at U_L	45mA, maximum
Power consumption at U_L	0.34W, maximum
Segment supply voltage U_S	24VDC (nominal)
Nominal current consumption at U_S	50mA, maximum
Total internal power consumption	1.2W, maximum

Line Connection for Module IC220STR001	
Connection method	Power connector or power bridge
Terminal strip	X11 and X12
Number of pins	5: L1, L2, L3, N, PE (not leading)
Permissible cable cross-section	Up to 2.5mm^2 (14 AWG)
Nominal operating voltage	400VAC
Voltage range	187VAC to 440V AC + 0%, minimum, with safe isolation between line and SELV *Tolerances outside the voltage range are not permitted.*
Frequency	50Hz or 60Hz. *The supply of the line voltage through a frequency inverter is not permitted.*
Current load (incoming line)	20A, maximum
Wiring	TSE wiring Varistor 460VAC

Motor Output for Module IC220STR001	
WARNING: Dangerous voltage. Switch off the line voltage before working with the Motor Starter module or the motor. CAUTION: Avoid a motor output short-circuit, which may damage the module electronics.	
Number of motor outputs	One (3-phases), short-circuit protected with external fuse of 16A. (total range protection for semiconductor type gR).
Number of pins on output terminal strip X10	Four: T1, T2, T3, ⏚
Conductor cross-section	1mm^2 (18AWG) minimum, to 2.5mm^2 (14 AWG) maximum
Degree of protection	Protection against direct touch
Wiring	Varistor 460VAC
Note: The minimum motor current of 0.1A must be maintained in the operating state, or the error message "Power level cannot be controlled" will be generated.	
Motor power ranges	
Motor voltage	400V
Number of motor poles	4
Motor power	0.18kW to 1.5kW
The selection of an appropriate motor depends on the nominal motor current, which ranges from 0.2A to 3.6A.	

Motor Protection for Module IC220STR001			
Trip class	According to Class 10A of IEC 60947-4		
Quick Shutdown	> 20.3A after 300ms		
Configurable range	0.2A to 3.6A		
Typical Response Behavior	*Current*	1.5 x I_N	7.2 x I_N
	*Release Time*	T_P < 120s	2s < T_P < 10s
	If the current is disconnected due to an overcurrent, wait at least 60 seconds to ensure successful acknowledgement of the error.		

Current Monitoring for Module IC220STR001	
Monitored phase	T1
Measuring range	0 to 25A
Resolution	14mA
Supply of the current detection	From the 7.5V communications power

Diagnostic Messages for Module IC220STR001	
Module error after error in self-test	Message to the controller.
Overcurrent	Error message in diagnostic code and displayed on ERR LED on module.
Power level cannot be controlled	

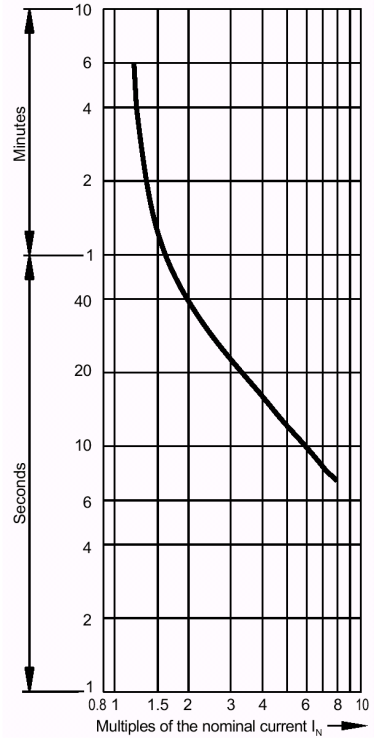
Specifications for Motor Starter Module IC220STR002

Motor Starter Module IC220STR002	
Switch	Mechanical contactor
Operating voltage (conductor voltage)	187VAC to 600VAC
Power frequency	50Hz or 60Hz
Nominal current range	0.2A to 8.0A up to 40 degrees C (104F) Derating on 6A at 55 degrees C (131F)
Minimum current	>5mA (switching element)
Power	3.7kW fpr AC 3 operation (4-position synchronous motor)
Usage category	According to AC 3
Service life	1.5 million cycles (nom. current = 8.0A) to 10 million cycles (nom. current up to 3.0A)
Switching frequency	5 switching operations per minute, maximum.
Phase angle	cos φ = >0.3
Motor starting time	1 second maximum
Internal Protection	None
Control voltage for the Motor Starter Module	24V segment voltage (when the segment voltage is switched off, the Motor Starter Module cannot be switched on and the motor is off.
External short-circuit fuse	Type 2 (contactor still functions after a short-circuit): 20A gG
Contact wiring	None

Power Consumption for Module IC220STR002	
Communications power U_L	7.5V
Current consumption at U_L	50mA maximum
Power consumption at U_L	0.375W, maximum
Segment supply voltage U_S	24VDC (nominal)
Nominal current consumption at U_S	160mA
Total internal power consumption	4.2W, maximum
Permissible voltage range for segment voltage U_S	19.2VDC to 28.8VDC, including ripple

Line Connection for Module IC220STR002	
Connection method	Power connector or power bridge
Terminal strip	X11 and X12
Number of pins on	5: L1, L2, L3, N, PE (not leading)
Permissible cable cross-section	Up to 2.5mm^2 (14 AWG)
Nominal operating voltage	400VAC
Voltage range	187VAC minimum - up to 519VAC with safe isolation between line and SELV - up to 600VAC with basic insulation between line and SELV
Frequency	50Hz / 60Hz
Current load (incoming line)	20A maximum
Supplying the line voltage through a frequency inverter is NOT permitted!	
Current load (incoming line)	20A maximum
Wiring	Y capacitors, Varistor 625V

Motor Output for Module IC220STR002	
WARNING: Dangerous voltage. Switch off the line voltage before working with the Motor Starter module or the motor. CAUTION: Avoid a motor output short-circuit, which may damage the module electronics.	
Number of motor outputs	One (3 phases). Short-circuit protection with external 16A fuse (total range protection for semiconductor type gR).
Number of pins on output terminal strip X10	Four: T1, T2, T3, ⏚
Conductor cross-section	1mm^2 (18AWG) minimum, to 2.5mm^2 (14 AWG) maximum
Degree of protection	Protection against direct touch
Wiring	Varistor 460VAC
Motor power ranges Motor voltage Number of motor poles Motor power	 400V 4 0.18kW to 3.7kW (0.241 hp to 4.958 hp)
The selection of appropriate motors depends on the nominal motor current ranging from 0.2A to 8.0A	

Motor Protection for Module IC220STR002			
Current range	0.2 Amp to 8.0 Amps. The motor current is measured in the T1 phase		
Motor protection relay	Inserted using a single-phase current measurement in unconnected phase T1		
Trip class	According to Class 10A of IEC 60947-1990		
Quick Shutdown	≥20.3A after 300ms		
Typical Response Behavior	*Current*	*1.5 x I_N*	*7.2 x I_N*
	*Release Time*	T_P < 120s	2s < T_P < 10s
	If the current is disconnected due to an overcurrent, wait at least 60 seconds to ensure successful acknowledgement of the error.		

Current Monitoring	
Monitored phase	T1
Measuring range	0 to 25 Amps
Resolution	14mA
Supply of the current detection	from the 7.5V communications power

Manual Mode Input	
Number	1
Terminal Strip	X32
Number of pins on X32	4
Conductor cross-section	1.5mm^2 (16AWG), maximum
Input current	Approximately 5mA at U_S = 24V
Filter time	0.2ms, typical
Potential	Potential of the supply voltage U_S

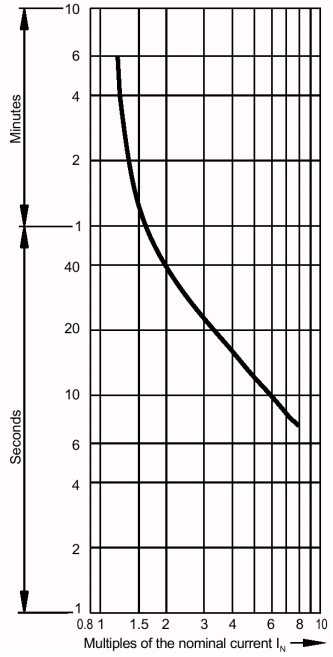
Diagnostic Messages for Module IC220STR002	
Module error after error in self-test	Message to the controller.
Overcurrent	Error message in diagnostic code and displayed on ERR LED on module.
Power level cannot be controlled	

Specifications for Motor Starter Module IC220STR003

Motor Starter Module IC220STR003	
Switches	Electronic hybrid switches, two-phase switching. Connection, disconnection, and reversing is carried out using thyristors that are jumpered by relays in the conductive state.
Operating voltage (conductor voltage)	187VAC to 440VAC +0% minimum
Power frequency	50Hz or 60Hz
Nominal current range	0.2A to 3.6A
Minimum current	100mA
Power	1.5kW fpr AC 3 operation (4-position synchronous motor)
Usage category	According to AC 3
Switch-on time	1 second minimum
Switch-off time	1 second minimum
Phase angle	cos φ = >0.3
Motor starting time	0.5 second maximum
The minimum permissible motor current of 0.1A per phase must be maintained during operation, or the error message "Power level cannot be controlled" will be generated.	
Internal Protection	Fuse 6.3 x 32 10 AT in the switched phases
Control voltage for the Motor Starter Module	24V segment voltage (when the segment voltage is switched off, the Motor Starter Module cannot be switched on and the motor is off.
WARNING: When the segment voltage is switched off, the motor is not disconnected.	
WARNING: If thermal damage occurs to the module, it is not able to switch off the motor. This error state is indicated by the error code 10 in the module input data. It is important to provide an alternative means of switching off the motor with a mechanical switch.	
WARNING: Do not attempt to repair or perform other work on the Motor Starter Module. The fuses inside the module protect both personnel and system equipment. If these fuses blow, for example, in the event of a short-circuit at the motor output, the module must be replaced.	

Power Consumption for Module IC220STR003	
Communications power	7.5V
Current consumption from the local bus	45mA, maximum
Power consumption from the local bus	0.34W, maximum
Segment supply voltage U_S	24VDC (nominal)
Nominal current consumption at U_S	50mA, maximum
Total internal power consumption	1.2W, maximum

Motor Output for Module IC220STR003	
WARNING: Dangerous voltage. Switch off the line voltage before working with the Motor Starter module or the motor. **CAUTION**: Avoid a motor output short-circuit, which may damage the module electronics.	
Number of motor outputs	One (3-phases), short-circuit protected with external fuse of 16A. (total range protection for semiconductor type gR).
Terminal strip	X10
Number of pins	4: T1, T2, T3, ⏚
Conductor cross-section	1mm^2 (18AWG) minimum, to 2.5mm^2 (14 AWG) maximum
Degree of protection	Protection against direct touch
Wiring	Varistor 460VAC
Nominal load	Three-phase asynchronous motors
Note: The minimum motor current of 0.1A must be maintained in the operating state, or the error message "Power level cannot be controlled" will be generated.	
Motor power ranges	
Motor voltage	400V
Number of motor poles	4
Motor power	0.18kW to 1.5kW
The selection of an appropriate motor depends on the nominal motor current, which ranges from 0.2A to 3.6A.	

Motor Protection for Module IC220STR003			
A motor-protection relay is inserted using a single-phase current measurement in unconnected phase T1. The motor current is measured in the T1 phase.			
Trip class	According to Class 10A of IEC 60947-4 1990		
Quick Shutdown	> 20.3A after 300ms		
Configurable range	0.2A to 3.6A		
Typical Response Behavior	*Current*	*1.5 x I_N*	*7.2 x I_N*
	*Release Time*	T_P < 120s	2s < T_P < 10s
	If the current is disconnected due to an overcurrent, wait at least 60 seconds to ensure successful acknowledgement of the error.		

Current Monitoring for Module IC220STR003	
Monitored phase	T1
Measuring range	0 to 25A
Resolution	14mA
Supply of the current detection	From the 7.5V communications power

Diagnostic Messages for Module IC220STR003	
Overcurrent	Error message in diagnostic code and displayed on ERR LED on module.
Power level cannot be controlled	

Ordering Information

Product Type	Catalog Number
Motor Starter Module, Direct, 1.5 KW /400 VAC	IC220STR001
Motor Starter Module, Direct, 3.7 KW / 400 VAC	IC220STR002
Motor Starter Module, Reversing, 1.5 KW / 400 VAC	IC220STR003
Motor Starter Brake Module, 5 VDC to 31 VDC	IC220ACC100
Motor Starter Brake Module, 12 VDC to 400 VDC, 20VAC to 400VAC	IC220ACC101
Motor Starter Power Connector	IC220ACC103
Motor Starter Power Bridge	IC220ACC104
Motor Circuit Connector (quantity 10)	IC220ACC105
Thermistor Module, 1 Point	IC220MDD850
I/O Terminal Strip, quantity 10 (for Thermistor Module)	IC220TBK081

Chapter 2 Installing VersaPoint Motor Starter Modules

This chapter provides specific installation information for the VersaPoint Motor Starter Modules, including:

- Safety Requirements
- Module Installation
- Connectors and Connection Points
- Connecting 24V Module Power
- Connecting the Power Source for the Motor
- Connecting Power from the Module to the Motor
- Protecting the Motor
- Connecting a Motor Starter Brake Module and Brake
- Wiring Two Motor Starter Modules IC220STR002 for Reversing
- Module LEDs
- Internal Circuit Diagram

To complete the installation, you will also need to refer to the general system installation instructions in the *Network Interface Unit User Manual* for your system.

Configuring the Nominal Current

During system operation, the module monitors motor current by comparing it to a configured nominal motor current. If the actual motor current is too high, the module interprets it as an overcurrent error, and shuts down the motor. At startup and after a reset, the nominal current defaults to 0.2 Amp. If a higher nominal current is preferred for the application, it can be changed by the system host as explained in chapter 3.

If the actual motor current is less than 0.1 Amp during operation, the module also shuts down the motor. See chapter 3 for more information.

Safety Requirements

The Motor Starter Module and connected machines are used in high-power industrial plants. During operation, this equipment has dangerous, live, moving or rotating parts. It can pose considerable risk of personal injury or death and of damage to equipment.

WARNINGS

Only qualified personnel may work on the Motor Starter Module or system. Unqualified personnel may not work on the Motor Starter Module, on the machines, or in their vicinity. Qualified personnel are people who, because of their education, experience and instruction and their knowledge of relevant standards, regulations, accident prevention and service conditions, have been authorized by those responsible for the safety of the plant to carry out any required operations and who are able to recognize and avoid any possible dangers. (Definitions for skilled workers according to EN50110-1.)

When work is being carried out on the Motor Starter Module or system, the relevant product documentation must always be kept at hand and referred to. The instructions given on this document must be followed during installation and startup. The additional information presented on this document should be understood and applied in an appropriate manner.

GE Intelligent Platforms cannot guarantee the suitability of the procedures described or the circuit suggestions for the relevant application.

Correct Usage

WARNINGS

The Motor Starter Module is only to be used as specified in this manual.
GE Intelligent Platforms accepts no liability if the device is used for anything other than its designated application.

Notes for Reversing Applications

Do not implement a reversing application. by combining two Motor Starter Modules (IC220STR001). **Do not use Motor Starter Module IC220STT001 to control pole-reversing motors (dual speed) !**

Motor Starter Module IC220STR003 is intended for reversing applications. Alternatively, two Motor Starter Modules IC220STR002 can be combined for reversing applications as shown later in this chapter.

For module IC220STR003, the motor must have come to a stop before the direction of rotation can be changed.

Installation Safety Instructions

WARNINGS

Do not replace modules while power is connected.

Before removing or installing a VersaPoint module, disconnect power to the entire I/O Station. Be sure the entire I/O Station is reassembled before switching the power back on.

Dangerous Voltage

Carry out all work on the Motor Starter Module and the connectors when the power is not connected. Before working with the Motor Starter Module or system, disconnect the AC line voltage and make sure it cannot be switched on again. If this precaution is not followed, personal injury or death may result.

The semiconductors in the module disconnect the motor without electrical isolation even when switched off. Due to the leakage currents of the semiconductors, an exposed dangerous voltage may be present at the motor connection even when the power levels are disconnected.

Be sure that phase T1 is not connected and is always present at the motor connection.

Take Measures to Suppress Interference

Switching three-phase induction motors when they are not at zero current generates electromagnetic disturbance that can adversely affect the function of the system. In order to limit this type of interference, appropriate measures must be taken in accordance with standard EN 60204-1:1998 (Electrical Equipment of Machines) to attenuate the interference at its source (the motor).

In practice, RC interference suppression elements have proven to be effective.

Segment Voltage 24V Switched Off Does NOT Disconnect Motor

When the segment voltage is switched off, the motor is not disconnected.

Provide an External Switch to Control the Motor

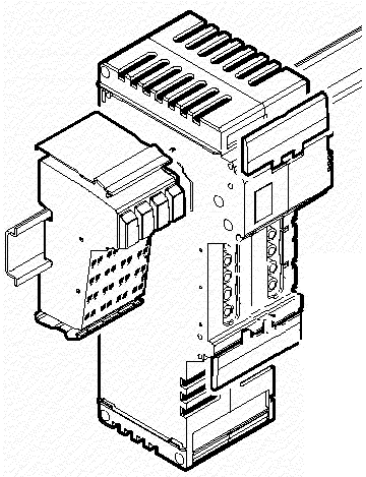
If thermal damage occurs to the module, it is not able to switch off the motor. This error state is indicated by the error code 10 in the module input data. It is important to provide an alternative means of switching off the motor with a mechanical switch.

Do not attempt to repair or perform other work on the Motor Starter Module.

The fuses inside the module protect both personnel and system equipment. If these fuses blow, for example, in the event of a short-circuit at the motor output, the module must be replaced.

Module Installation

A VersaPoint Motor Starter module must be panel-mounted on a horizontal DIN rail as shown below.



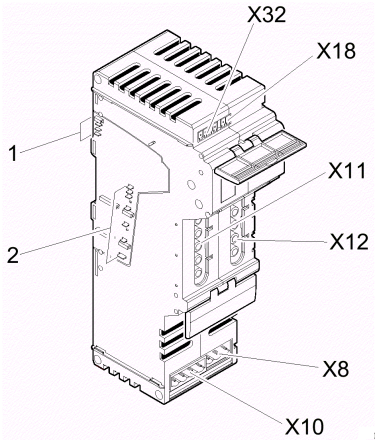
As the illustration shows, a Motor Starter Module is larger than other types of VersaPoint modules. Its dimensions are:

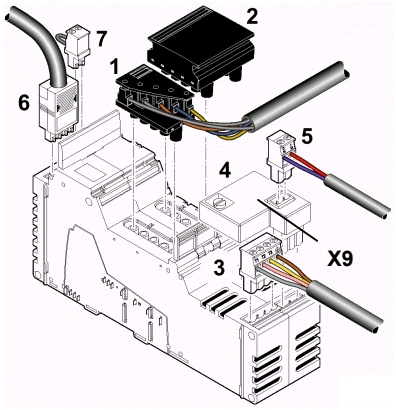
63mm x 224mm x 109mm (2.48in x 8.82in x 4.29in)

At least 50mm (2 inches) of space is required above and below the Motor Starter module to assure adequate module ventilation.

Connectors and Connection Points

The lefthand diagram below shows the connection points on a Motor Starter Module. The righthand diagram shows the devices that may be connected to them.





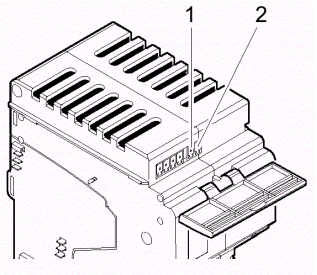
Item	Description	Item	Description
1	Data jumper for the I/O Station. Connects to previous module		
2	Voltage jumper for the low level signals, U_M, U_S, U_{ANA}, U_L, GND, FE. Connects to previous module		
X8	Connection for optional Motor Starter Brake Module including brake switch and connection for brake (X9)	4	Motor Starter Brake Module, IC220ACC100
		5	Connector to optional brake (on X9)
X10	Connection for the motor output: T1, T2, T3, ⏚	3	Motor Output Connector
X11	Connection for the incoming line L1, L2, L3, N, ⏚	1	Incoming line, here: Motor Starter Power Connector IC220ACC103
X12	Connection for the outgoing line. L1, L2, L3, N, ⏚	2	Optional outgoing line, Motor Starter Power Bridge IC220ACC104
X18	Enabling the power level/connection for 24V isolation	7	Jumper for 24V segment power. A switch to control 24V power can be substituted for this jumper
X32	Connection for manual mode / Motor Starter Pendent	6	Optional Motor Starter Pendent, IC220ACC102

Connecting 24V Module Power

Power for module operation comes from the NIU module or separate power supply as described in the NIU User's Manual. Connecting the modules on the DIN rail automatically creates jumpers between modules for I/O Station power.

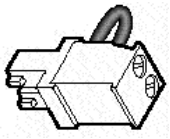
Enabling the Power Level / 24V Isolation

The two pins shown below control the 24V segment voltage for the Power Monitor Module. When this 24V control voltage is not present, the contacts are always open and the brake is always applied (the motor is decelerated).



Pin	Description
1	1 (24 V segment voltage US)
2	2 (enable power level)

The Motor Starter Module is supplied with a jumper inserted between these pins. If no switch is connected to these pins, the jumper can remain inserted. In that case, the Motor Starter Module will be enabled by the directly-available 24V segment voltage.



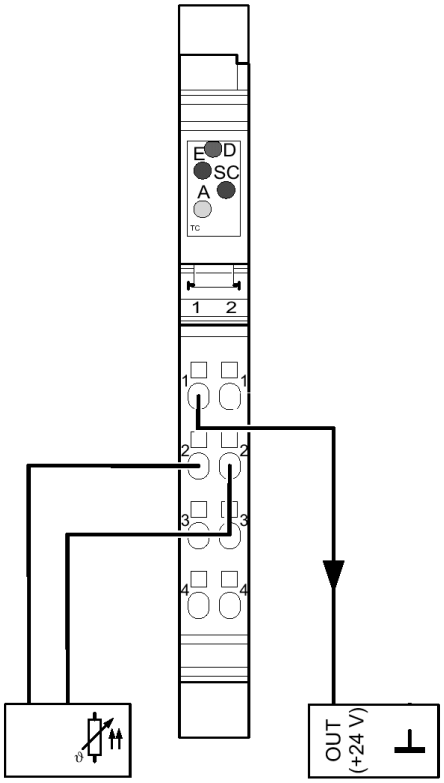
Alternatively, an external switch can be wired to the module via these terminals, and used to control the 24V segment voltage. If an external switch is installed, the power level of the module is enabled only when the switch is closed.

WARNING

Be sure the motor is switched off before supplying control power to the module.

Connection for a Thermistor Module Switching Output

If the switching output of a VersaPoint Thermistor Module will directly control 24V power to the Motor Starter Module, the switching output can be connected to the Motor Starter Module as shown below (right side of the diagram). See chapter 6 for more information about using a Thermistor Module.



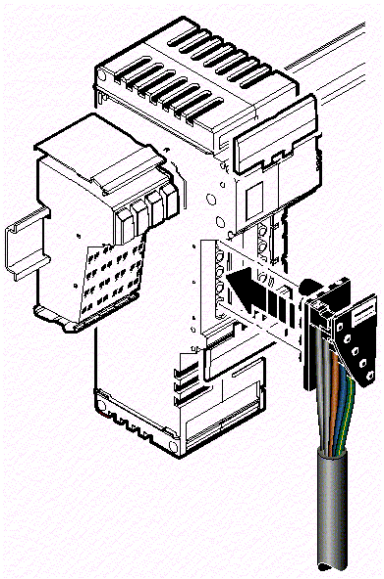
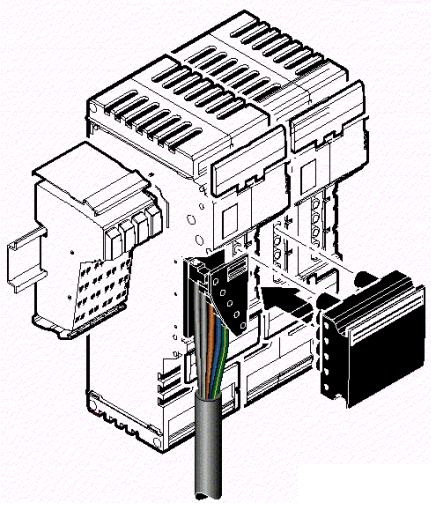
CAUTION

Only connect pin 1.1 on the Thermistor Module to the Motor Starter Module. DO NOT connect the ground terminal of the switching output. (pin 2.1 on the Thermistor Module) . The ground of the switching output is internally connected via the voltage jumper.

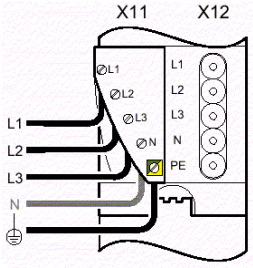
In some applications, the system host will shut down the motor if it receives an error message from the Thermistor Module. In that type of system, the Motor Starter Module should not be connected to the switching output of the Thermistor Module. See chapter 6 for details.

Connecting the Power Source for the Motor

Power for the motor can be connected to the Motor Starter Module using Power Connector IC220ACC103. When another Motor Starter module is connected to the first (for example, when two IC220STR002 modules are used together to implement a reversing application), power can be passed to the second module using a Motor Starter Power Bridge, IC220ACC104.

Installing the Power Connector	Inserting a Power Bridge
	

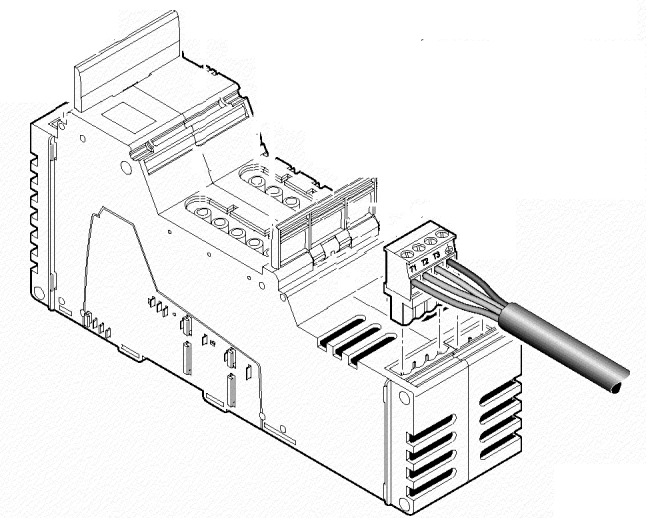
The pins on the power terminals have the following assignments:



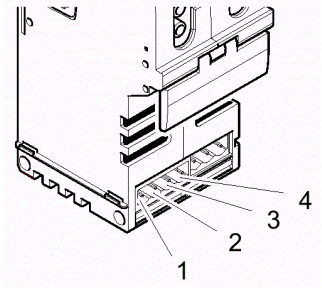
X11 (Line In)	X12 (Line Out)
L1	L1
L2	L2
L3	L3
N	N
PE	⏚

Connecting Power from the Module to the Motor

Attach the cable for the motor to the connector on the lower left corner of the module.



Pin assignments for this cable are shown below:



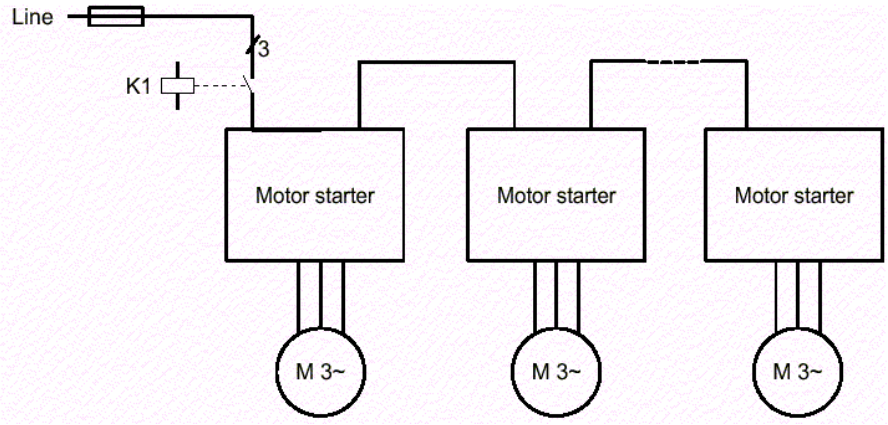
Pin	Assignment
1	Motor:T1
2	Motor: T2
3	Motor: T3
4	Motor: ⏚

Protecting the Motor

The motor does not shut down automatically under every type of error condition.

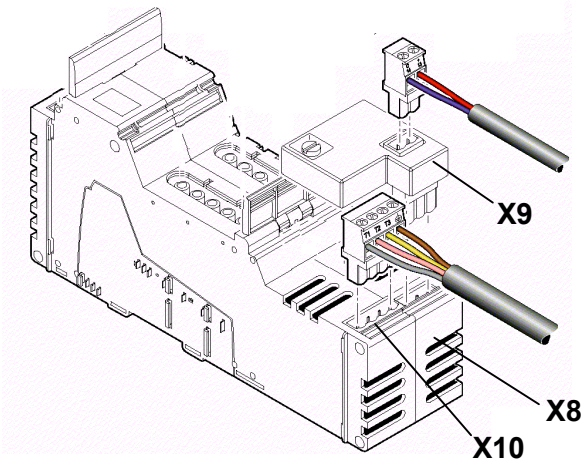
CAUTION

If an error occurs, it is important to be able to switch off the 400V operating voltage of the Motor Starter Module, as shown in the example below, to prevent damage to the motor.



Connecting a Motor Starter Brake Module and Brake

The optional Motor Starter Brake module (IC220ACC100 or ACC101) and brake cable should be connected as shown below. Be sure the brake is connected with the correct polarity, otherwise it may not operate correctly.



Wiring Two Motor Starter Modules IC220STR002 for Reversing

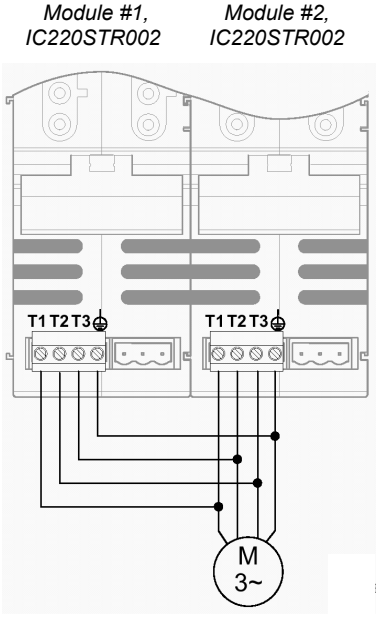
Reversing applications can only be set up using Motor Starter Module IC220STR103 (Reversing, 1.5KW/ 400W)), or two Motor Starter Modules IC220SRT002 (Direct, 3.7KW / 400W).

CAUTION

DO NOT ATTEMPT to implement a reversing application using Motor Starter Modules IC220STR001!

Connecting Two Modules IC220STR002

To set up a reversing application using two Motor Starter Modules IC220STR002, connect the motor as shown below. A Motor Starter Power Bridge (IC220ACC104), can be used to transfer motor power from the first module to the second.



Application Software Required for a Reversing Application

In this application, it is not possible to interlock the IC220STR002 modules using the hardware; they must be interlocked using the application software in the system host. Because interlocking is controlled by the system host, it is not possible in Manual Mode.

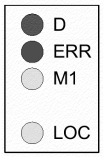
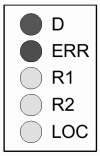
WARNING

A phase-to-phase short-circuit can occur if this type of reversing application is switched too fast. For example, the arc of the contactor switching off has not extinguished yet, and the contacts of the contactor switching on have already been closed. To avoid this risk, both Motor Starter Modules (contactor coils) must be switched off during reversing for at least 100ms.

Module LEDs

During operation, the module LEDs provide local diagnostics showing the state of the module, the motor, and whether or not the module is currently being controlled locally (for example, by a Motor Starter Pendent).

The LEDs present depend on the module type.

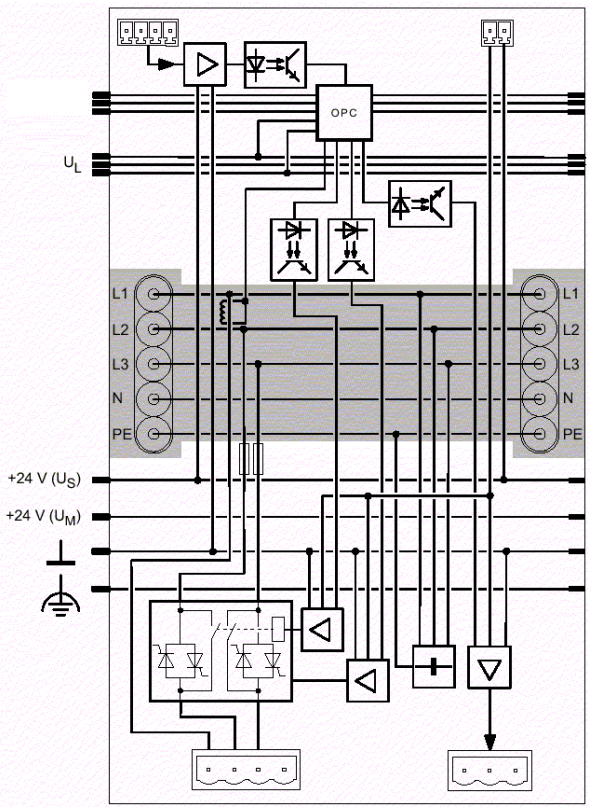
IC220STR001, IC220STR002	IC220STR003
	

For the two direct-type Motor Starter Modules, IC220STR001 and STR002, the M1 LED shows the status of the motor. For reversing-type module IC220STR003, LEDs R1 and R2 show the status of the motor in each of its two directions.

LED	Color	Meaning
D	*Green LED*	*Diagnostics*
	ON:	I/O Station communications are active
	Flashing:	
	0.5 Hz: (slow)	Communications power is present, but I/O Station communications not active
	4Hz: (fast)	Communications power is present, but local connection to the module has failed; modules to the right of the module are also affected.
	OFF:	Communications power is not present, no local communications
ERR	*Red LED*	*Group error message/motor protection*
	ON:	Operational fault (motor protection has been triggered, power level cannot be controlled)
	OFF:	No error
M1, R1 or R2	*Yellow LED*	*M1: Motor Status* *R1: Motor Status in Direction of Rotation 1* *R2: Motor Status in Direction of Rotation 2*
	ON:	Motor is switched on.
	OFF:	Motor is not switched on
LOC	*Yellow LED*	*Manual mode (local); usually controlled by a Motor Starter Pendent*
	ON:	Manual mode is active
	OFF:	Manual mode is not active

Internal Circuit Diagram

The same basic circuitry and connectors of an electronic Motor Starter Module are shown below:



X32 connector for manual mode

X18 connector for enabling 24V isolation

Amplifier

Optocoupler

Protocol chip (bus logic incl. Voltage conditioning)

Line connection

Current transformer

Fuse

Relay

Thyristor diode

Capacitor

Isolated area

X10 connector for motor output

X8 connector for external brake module

Ground

Functional earth ground

Voltage jumper

Chapter 3 Data Exchanged by the Motor Starter Module and the System Host

This chapter explains how a system host exchanges information with a Motor Starter module in a VersaPoint I/O Station.

- Exchanging Data with a Motor Starter Module
  - The Host Sends Output Data
  - The Module Provides Input Data
  - The Output / Input Data Cycle
- Output Data: Configuring the Nominal Motor Current
  - Entering the Nominal Motor Current
  - Configuration Example
- Output Data: Sending Control Commands
  - Using the Brake Commands
  - Enabling Manual Mode
  - Module IC220STR002: Disabling Minimum Current Checking
  - Acknowledging a Reset
  - Controlling the Motor
- Input Data: Monitoring the Motor Starter Module
  - Monitoring the Motor Current
    - Calculating the Actual Motor Current as a Percent
    - Calculating the Actual Motor Current in Amps
  - Checking for Manual Mode Active
  - Monitoring the Motor's On/Off State
  - Reading Status and Error Messages
    - Error Code 1 0 : Power Level Cannot be Controlled
    - Error Code 1 1 : Overcurrent

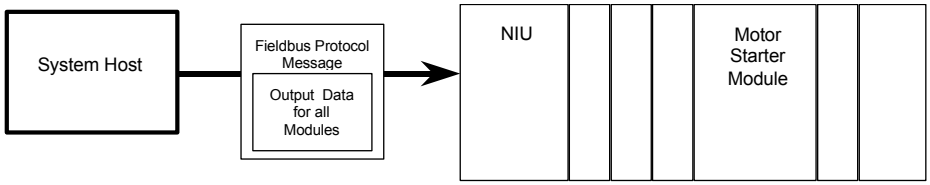
Exchanging Data with a Motor Starter Module

A system host exchanges data with the Network Interface Unit in a VersaPoint I/O Station using the appropriate bus protocol (for example, Profibus or DeviceNet). Protocol details are described in the each *Network Interface Unit User's Manual*.

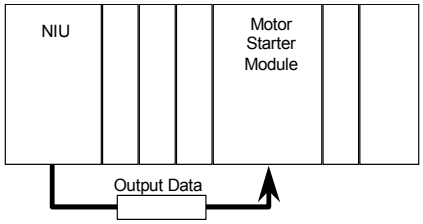
For all bus protocols, the content of the actual module data exchanged between the host and the NIU is the same.

The Host Sends Output Data

Each output message from the host contains all of the output data for the I/O Station. The system host must sequence the output data to reflect the data type and module order.



The NIU places the data in its own memory, then regularly sends the output data to the modules in its I/O Station. The content of the data itself is not meaningful to the NIU. A Motor Starter module receives one byte of output data from the host via the NIU.



A Motor Starter module interprets the one byte of output data it receives from the NIU as one of the configuration or control commands described in this chapter.

Loss of Communications with the Host

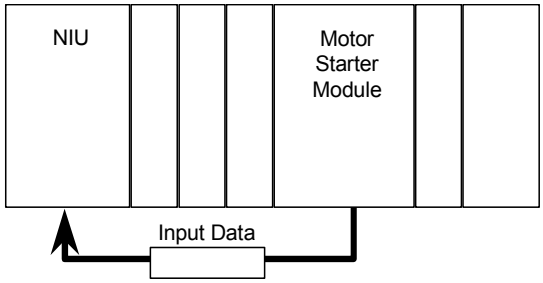
If the I/O Station is reset or if system communications stop for 640ms, the Motor Starter Module immediately begins decelerating the motor shaft. If an optional Motor Starter Brake Module is installed on the Motor Starter Module, the brake is automatically activated.

It is still possible to control the motor locally using an optional Motor Starter Pendent or similar switching device, even during a system reset or if system communications are lost.

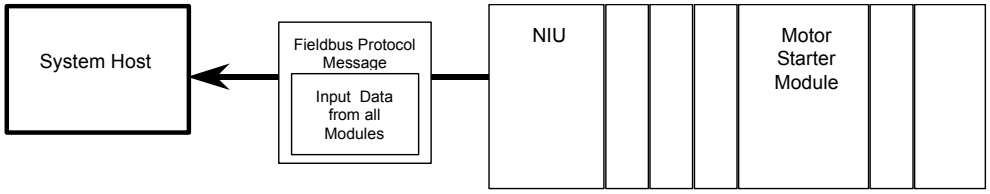
The Module Provides Input Data

After receiving commands in the output data, the Motor Starter Module performs the commanded function. It then sets the content of its one input data byte accordingly. The input data byte provides information about the operation of the motor, about error conditions, and about the motor current. Input data is described later in this chapter.

The NIU regularly reads the input data from the module and stores it in memory. Again, the content of the input data is not meaningful to the NIU.



The system host must read the input data from the NIU according to its specific communications protocol.



The Output / Input Data Cycle

Because of the asynchronous processing times of the host, the network, and the NIU, if the host sends commands too rapidly, the output data in the NIU can be overwritten by the host before the NIU sends it to the module.

After sending a command to a Motor Starter Module in the output data, the system host should evaluate the input data from the module before sending its next command.

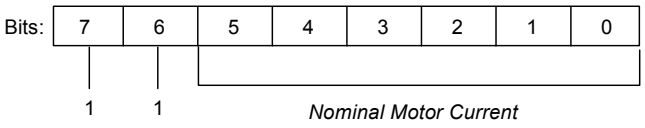
Output Data: Configuring the Nominal Motor Current

The configured nominal motor current provides protection against overcurrent. If the default of 0.2 Amp is satisfactory it does not need to be changed.

The host can reconfigure the nominal motor current using the module's output data byte. The motor is automatically switched off during configuration. Note that the configured nominal input current level is not stored through loss of power. If the 7.5V power supply U_L fails, the host needs to reconfigure the nominal current.

Configuring the Nominal Motor Corrent Value

For configuration, output bits 7 and 6 of the module's output byte are set to 1. The additional bits specify the nominal current value.



Set to 1 for Configuration mode

The table below shows all nominal current values. For each nominal current, it lists equivalent decimal and hex values for bytes 0-5 and for the entire byte (with bits 7 and 6 set to 1). All modules can use the values shown in the first two sections of the table. Only module IC220STR002 can use the values in the righthand section.

All Modules		
Amps	*Bits 0-5 dec (hex)*	*Byte dec (hex)*
0.20	0 (00)	192 (C0)
0.25	1 (01)	193 (C1)
0.30	2 (02)	194 (C2)
0.35	3 (03)	195 (C3)
0.40	4 (04)	196 (C4)
0.45	5 (05)	197 (C5)
0.50	6 (06)	198 (C6)
0.55	7 (07)	199 (C7)
0.60	8 (08)	200 (C8)
0.65	9 (09)	201 (C9)
0.70	10 (0A)	202 (CA)
0.75	11 (0B)	203 (CB)
0.80	12 (0C)	204 (CC)
0.85	13 (0D)	205 (CD)
0.90	14 (0E)	206 (CE)
0.95	15 (0F)	207 (CF)
1.00	16 (10)	208 (D0)
1.05	17 (11)	209 (D1)
1.10	18 (12)	210 (D2)
1.15	19 (13)	211 (D3)
1.20	20 (14)	212 (D4)
1.30	21 (15)	213 (D5)

All Modules		
Amps	*Bits dec (hex)*	*Byte dec (hex)*
1.40	22 (16)	214 (D6)
1.50	23 (17)	215 (D7)
1.60	24 (18)	216 (D8)
1.70	25 (19)	217 (D9)
1.80	26 (1A)	218 (DA)
1.90	27 (1B)	219 (DB)
2.00	28 (1C)	220 (DC)
2.10	29 (1D)	221 (DD)
2.20	30 (1E)	222 (DE)
2.30	31 (1F)	223 (DF)
2.40	32 (20)	224 (E0)
2.50	33 (21)	225 (E1)
2.60	34 (22)	226 (E2)
2.70	35 (23)	227 (E3)
2.80	36 (24)	228 (E4)
2.90	37 (25)	229 (E5)
3.00	38 (26)	230 (E6)
3.20	39 (27)	231 (E7)
3.40	40 (28)	232 (E8)
3.60	41 (29)	233 (E9)

Module IC220STR002 ONLY		
Amps	*Bits dec (hex)*	*Byte dec (hex)*
3.80	42 (2A)	234 (EA)
4.00	43 (2B)	235 (EB)
4.20	44 (2C)	236 (EC)
4.40	45 (2D)	237 (ED)
4.60	46 (2E)	238 (EE)
4.80	47 (2F)	239 (EF)
5.00	48 (30)	240 (F0)
5.20	49 (31)	241 (F1)
5.40	50 (32)	242 (F2)
5.60	51 (33)	243 (F3)
5.80	52 (34)	244 (F4)
6.00	53 (35)	245 (F5)
6.20	54 (36)	246 (F6)
6.40	55 (37)	247 (F7)
6.60	56 (38)	248 (F8)
6.80	57 (39)	249 (F9)
7.00	58 (3A)	250 (FA)
7.20	59 (3B)	251 (FB)
7.40	60 (3C)	252 (FC)
7.60	61 (3D)	253 (FD)
7.80	62 (3E)	254 (FE)
8.00	63 (3F)	255 (FF)

Calculating the Nominal Current

It is also possible to calculate nominal current using one of the following equations:

Nominal Current from 0.2A to 1.2A:

Nom. current value (bits 5 to 0) = (Nom. current in Amps - 0.2A) / 0.05A

Nominal Current from 1.3A to 3.0A:

Nom. current value (bits 5 to 0) = (Nom. current in Amps + 0.8A) / 0.1A

Nominal Current from 3.2A to 3.6A (or 3.2A to 8.0A for Module IC220STR002, 3.7KW, ONLY):

Nom. current value (bits 5 to 0) = (Nom. current in Amps + 4.6A) / 0.2A

Configuration Example

In this example, the nominal motor current for the Motor Starter module will be configured to be 2.5 Amps.

Step 1: Find the correct nominal current value in the table. For 2.5 Amps, the table shows:

Amps	*Bits dec (hex)*	*Byte dec (hex)*
2.50	33 (21)	225 (E1)

Step 2: Enter the appropriate value in the output data to be sent to the module:

Output Byte:

Bits:	7	6	5	4	3	2	1	0
(binary)	1	1	1	0	0	0	1	1
(hex)	E				1			

Step 3: Wait until the module's input data indicates successful configuration. Input bits 7 and 6 will both be 0:

Input Byte:

Bits:	7	6	5	4	3	2	1	0

Error Code:
0 0 No status message
0 1 Nominal motor current not configured

Step 4: after successful configuration, the output byte is used for module control as described next in this section.

To configure the nominal motor current, follow these steps:

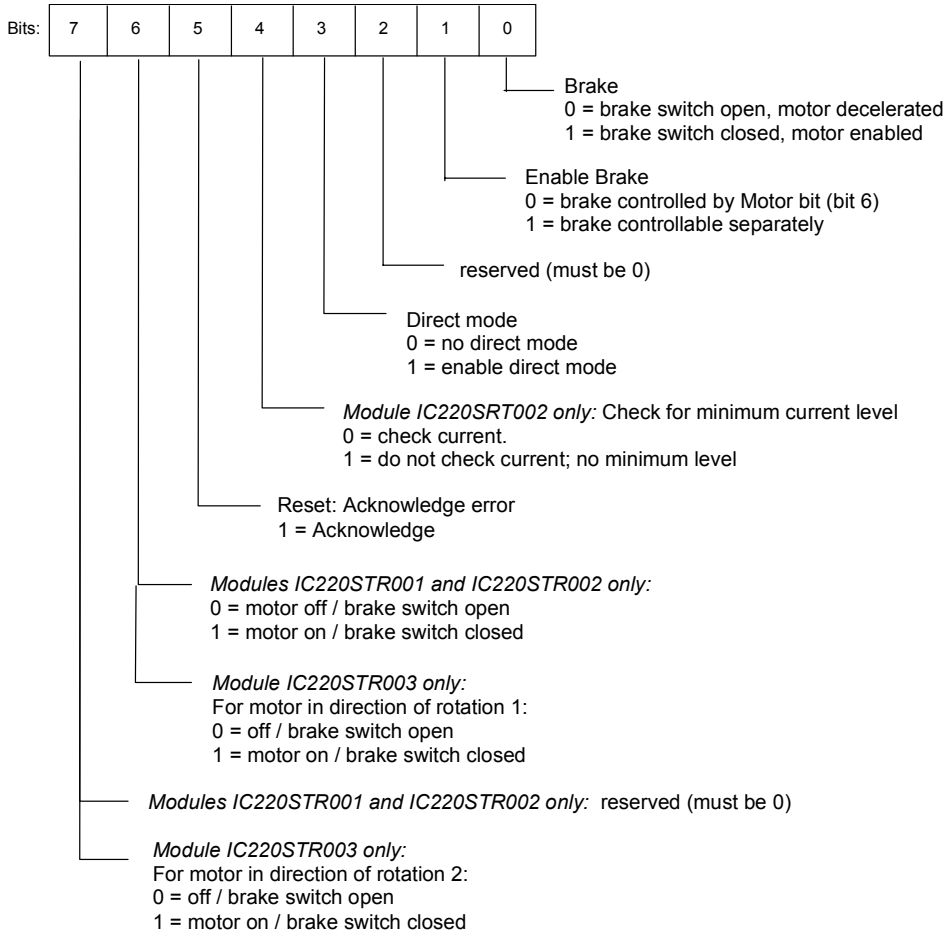
1. Write the parameter of the above table to the output byte
2. Check Bits 6 and 7 of the input byte
3. If bit 6 gets 0 or bit 7 gets 1 write zero to the output byte to finalize parameterization

If you want to automatically reconfigure the Motor Starter after a VersaPoint station reset (e.g. power cycle) execute the above steps again, when input byte bit 6 is 1 and bit 7 is 0.

Output Data: Sending Control Commands

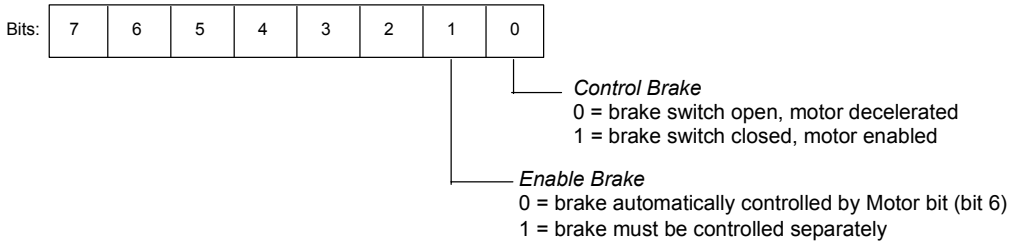
After configuring the nominal motor current, the system host sends control commands to the Motor Starter Module. The three types of Motor Starter Modules have different features, which are reflected in the use of the output control bits, as shown below.

Use of these control bits is described on the following pages.


Bits:
7
6
5
4
3
2
1
0
Brake
0 = brake switch open, motor decelerated
1 = brake switch closed, motor enabled
Enable Brake
0 = brake controlled by Motor bit (bit 6)
1 = brake controllable separately
reserved (must be 0)
Direct mode
0 = no direct mode
1 = enable direct mode
Module IC220SRT002 only: Check for minimum current level
0 = check current.
1 = do not check current; no minimum level
Reset: Acknowledge error
1 = Acknowledge
Modules IC220STR001 and IC220STR002 only:
0 = motor off / brake switch open
1 = motor on / brake switch closed
Module IC220STR003 only:
For motor in direction of rotation 1:
0 = off / brake switch open
1 = motor on / brake switch closed
Modules IC220STR001 and IC220STR002 only: reserved (must be 0)
Module IC220STR003 only:
For motor in direction of rotation 2:
0 = off / brake switch open
1 = motor on / brake switch closed

Using the Brake Commands (Bits 0 and 1)

If an optional Motor Starter Brake module and brake are connected to the Motor Starter Module, the system host ordinarily controls the brake automatically, using the motor control command bit(s). However, the brake can also be controlled independently using output bits 0 and 1.



For more information about the Motor Starter Brake modules, see chapter 5.

Enabling Brake Control (output bit 1)

To be able to switch the brake independently, brake control must first be enabled using the Enable Brake command.

- If the Enable Brake bit (1) is set to 0, the brake cannot be freely controlled; it is automatically controlled by tbe bit(s) controlling the motor.
- When the Enable Brake bit (1) is set to 1, the brake must be explicitly controlled using bit 0, even if an error occurs.
- If the Enable Brake bit (1) is reset to 0 after being set to 1, the brake is set according to the present state of the motor. If the motor is on, the brake is released. If the motor is off, the brake is enabled.

Controlling the Brake (output bit 0)

If independent control has been enabled using bit 1, then bit 0 can be used to control the operation of the brake.

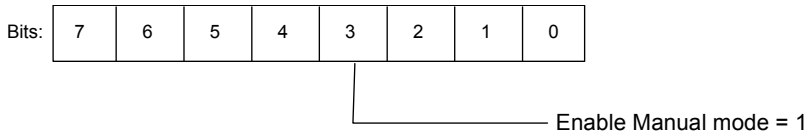
- When the Brake bit (0) is set to 0, the brake switch is opened, the brake takes effect, and the motor is decelerated.
- When the Brake bit (0) is set to 1, the brake switch is closed, the brake is released, and the motor is enabled.

Enabling Manual Mode (output bit 3)

If a Motor Starter Pendent or similar switching device is connected to the module's Enable and Motor Control inputs, Manual mode is enabled automatically. See chapter 4 for more information about using Manual Mode.

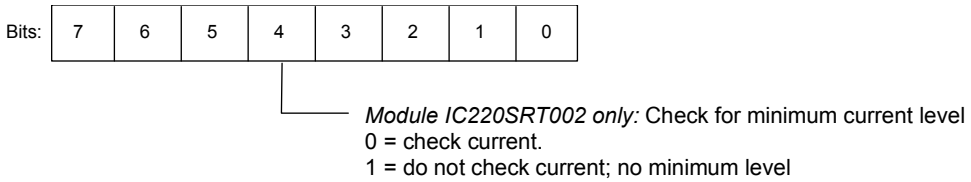
Manual Mode can be used WITHOUT a Motor Starter Pendent or similar switching device connected to the Motor Starter Module's Enable input. In that case, a switching device is connected only to the Motor Control input(s) and the Enable input is not connected. The system host must enable Manual Mode using bit 3.

- If output bit 3 is 0, Manual Mode is disabled.
- If output bit 3 is set to 1, the motor is switched directly by the Motor Control input(s) on the Motor Starter Module. In Manual mode, the motor cannot be controlled from the system host.



Module IC220STR002: Disabling Minimum Current Checking (output bit 4)

For Motor Starter Module IC220STR002 (3.7KW) ONLY, bit 4 of the output byte can be used to control whether or not the module will monitor the current level to make sure it is above 160mA.



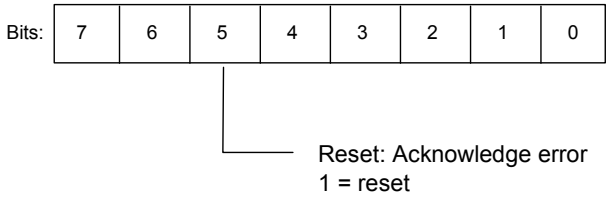
- If the Current Check bit (4) is 0, the module monitors the current level. If it is below 160mA, the module switches off the motor. The module notifies the system host by returning the message "Power level cannot be controlled" in its input data byte. Use of the input data byte is described later in this section.
- If the Current Check bit (4) is 1, the module does not monitor for minimum current.

CAUTION

If this bit is set to 0, the module cannot detect two-phase operation, so complete motor protection is not possible.

Acknowledging a Reset After an Error (output bit 5)

The host should use the Reset output bit to acknowledge an error after the cause of the error has been corrected.



If the error condition has shut down the motor, the cause of the error must be removed to restart the motor. After correcting the error condition, the control system should set the Reset Acknowledge output bit. The error can also be acknowledged in manual mode by inserting the Motor Starter Pendent, which places the module into manual mode.

If the underlying cause of the error is not removed, the error message will continue to be reported in the input data.

CAUTION

Following a critical error, do NOT issue repeated Reset commands before correcting the fault. Resetting the module before fully correcting the error can cause damage to the equipment or personal injury.

If the Motor Starter Module accepts the Reset Acknowledgement, the error codes are removed from the input data. The Reset bit must remain set until the error code is reset.

Timing for Reset Acknowledgement

- If an Overcurrent error (error code 11) occurs, an acknowledgement will not be accepted until recovery time of at least 60 seconds has passed.
- A Power Level error (error code 10) can be acknowledged after 0.3 second.

The module's built-in timer is not immediately reset after receiving a Reset Acknowledgement command. Depending on the reason for the shutdown, the counter is not reset until approximately 2 to 3 minutes after the motor is switched off.

Controlling the Motor (output bit 6)

For the direct-type Motor Starter Modules, IC220STR001 and IC220STR002, output bit 6 switches the motor on (bit 6 = 1) or off (bit 6 = 0).

For the reversing-type Motor Starter Module, IC220STR003, output bit 6 switches the motor on (bit 6 = 1) or off (bit 6 = 0) in direction of rotation 1.

If an optional Motor Starter Brake module is connected AND its use is not currently being controlled by bit 1 as described above, bit 6 also opens (bit 6 = 0) or closes (bit 6 = 1) the brake switch.

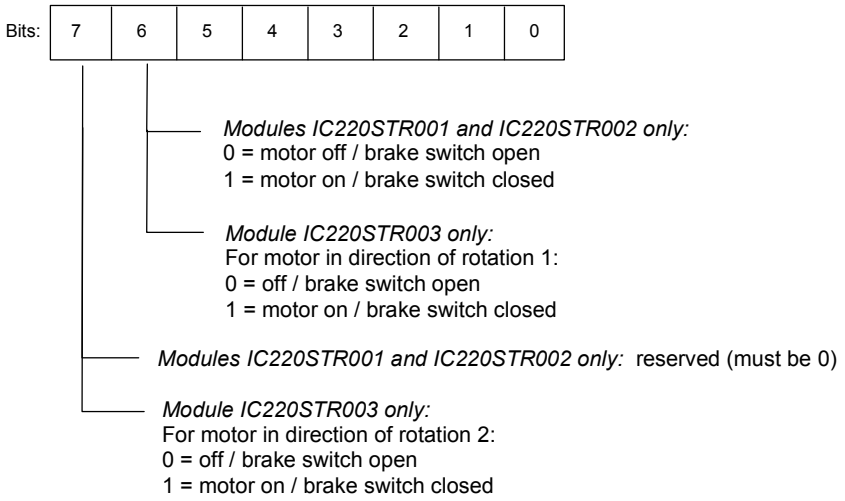
- If output bit 6 is zero, the motor is turned off. If the brake is present and being controlled, the brake switch is opened and the motor is decelerated.
- If bit 6 is 1, the motor is switched on. If the brake is present and being controlled, the brake switch is closed and the brake is released.

Controlling the Motor in Direction 2, Reversing-type Module: (output bit 7)

For the reversing-type Motor Starter Module, IC220STR003, output bit 6 switches the motor on (bit 7 = 1) or off (bit 7 = 0) in direction of rotation 2.

If an optional Motor Starter Brake module is connected AND its use is not currently being controlled by bit 1 as described above, bit 7 either opens (bit 7 = 0) or closes (bit 6 = 1) the brake switch as described above.

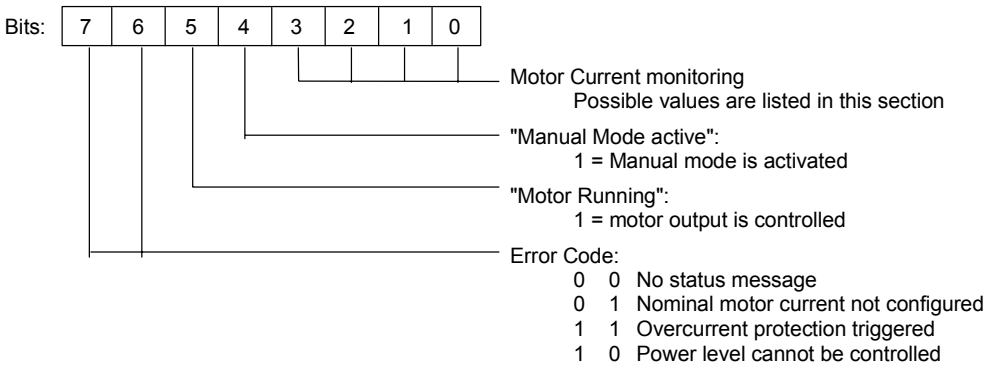
For the direct-type Motor Starter Modules, IC220STR001 and IC220STR002, output bit 6 is not used and must be set to 0.


Bits:
7
6
5
4
3
2
1
0
Modules IC220STR001 and IC220STR002 only:
0 = motor off / brake switch open
1 = motor on / brake switch closed
Module IC220STR003 only:
For motor in direction of rotation 1:
0 = off / brake switch open
1 = motor on / brake switch closed
Modules IC220STR001 and IC220STR002 only: reserved (must be 0)
Module IC220STR003 only:
For motor in direction of rotation 2:
0 = off / brake switch open
1 = motor on / brake switch closed

Input Data: Monitoring the Motor Starter Module

The Motor Starter Module provides one byte of status data to the control system.

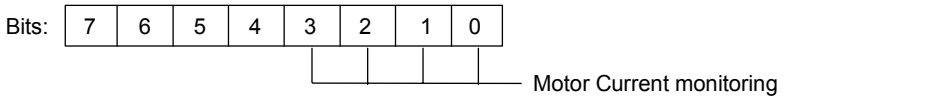
The system host can use this data to monitor the motor current and to determine whether the motor is running. It can also check for error conditions and for status of Manual Mode.



The system host should evaluate this input data before sending commands to the Motor Starter Module.

Monitoring the Motor Current (input bits 0-3)

The value in input bits 0 - 3 indicates the relationship between the actual current and the configured nominal current. This value is based on the actual current of phase T1, which corresponds to the output on pin 1 of the Motor Starter Module's motor output (connector X8).



T

he input data value is updated every 120ms.

Each binary / decimal value that may be represented in bits 0 to 3 corresponds to a specific relationship between the current values. The resolution of the motor current ratio I_{ACT} / I_{NOM} is 1/32.

The table below shows each possible value as both a ratio and a percentage. For example, if the value in bits 0 to 3 is equal to decimal 5, the actual input current is 91% of the configured nominal motor current.

As the table shows, the actual current can range from less than 75% to more than 122% of the configured nominal current.

Bits				Dec	Actual Current / Nom. Current	
3	2	1	0		Ratio	%
0	0	0	0	0	≤0.75	≤75
0	0	0	1	1	0.78	78
0	0	1	0	2	0.81	81
0	0	1	1	3	0.84	84
0	1	0	0	4	0.88	88
0	1	0	1	5	0.91	91
0	1	1	0	6	0.94	94
0	1	1	1	7	0.97	97

Bits				Dec	Actual Current / Nom. Current	
3	2	1	0		Ratio	%
0	0	0	0	8	1.00	100
0	0	0	1	9	1.03	103
0	0	1	0	10	1.06	106
0	0	1	1	11	1.09	109
0	1	0	0	12	1.13	113
0	1	0	1	13	1.16	116
0	1	1	0	14	1.19	119
0	1	1	1	15	≥1.22	122

Using the values read in bits 0 to 3, the application can calculate both the percentage values shown in the table above and the actual motor current by following the steps described on the next page.

Calculating the Actual Motor Current as a Percent

The system host can use the input data value to automatically calculate the actual current as a percentage of the nominal current. (This will produce the same percent values shown on the previous page). To get the actual current in Amps instead, see below.

To calculate the actual motor current as a percent, the application should substitute the decimal value from the input date into the following equation:

$$\text{Actual Current as a Percentage of Nominal Current} = \left(\frac{\boxed{\text{Decimal value 1 - 15 in bits 0 to 3}}}{32} + 0.75 \right) \times 100\%$$

Calculating the Actual Motor Current in Amps

If the application needs to calculate the actual motor current in Amps, use the equation below. For this calculation, the application must substitute both the decimal value from the input byte and the nominal current. The nominal current cannot be read from the module; it must already be known. If the nominal input current has not been reconfigured for the module as described previously in this chapter, the default is 0.2 Amp.

$$\text{Actual Current} = \left(\frac{\boxed{\text{Decimal value 1 - 15 in bits 0 to 3}}}{32} + 0.75 \right) \times \boxed{\text{Nominal Current in Amps}}$$

Example:

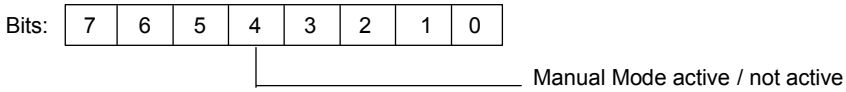
- the decimal value presently in bits 0 to 3 is 3 decimal.
- the configured nominal current is 1.1 Amp.
- substituting those two values gives the following equation:

$$\text{Actual Current} = \left(\frac{\boxed{3}}{32} + 0.75 \right) \times \boxed{1.1 \text{ Amps}}$$

Therefore, the actual motor current is 0.93 Amp in this example.

Checking for Manual Mode Active (input bit 4)

Bit 4 of the input data shows whether Manual Mode is active (1) or not active (0).

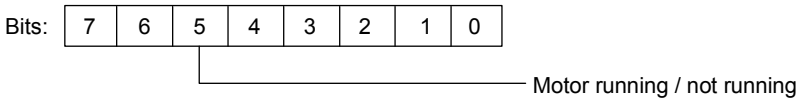


When Manual Mode is activated, bit 4 is set immediately. When switching from Manual Mode back to system control, the module maintains a 1-second delay time.

- If bit 4 is NOT set and there are no pre-existing error conditions, the motor can be started by the host immediately.
- If bit 4 is set, the module ignores all commands from the system host. When Manual Mode is active, the motor MUST be controlled locally.
  - If bit 4 is set AND a Motor Starter Pendent or similar switching device is connected to the Enable input on the Motor Starter Module:
    - the motor protection functions normally provided by the Motor Starter module are NOT present.
    - errors that occur are NOT reported in the input data byte. If Manual Mode is set while an error is present, that error no longer appears in the input byte. Switching to Manual Mode serves as an error acknowledgement that is equivalent to a Reset command. However, any error conditions that still exist upon exiting Manual Mode are again reported in the input data.
  - If bit 4 is set but the Enable input is controlled by the system host:
    - the motor protection functions remain available.
    - status messages (described later in this section) are still reported in the input byte.
- If Manual Mode was entered during the 60-second waiting time following an overcurrent error, the 60-second wait starts again when exiting Manual Mode. The overcurrent error cannot be acknowledged during this time.

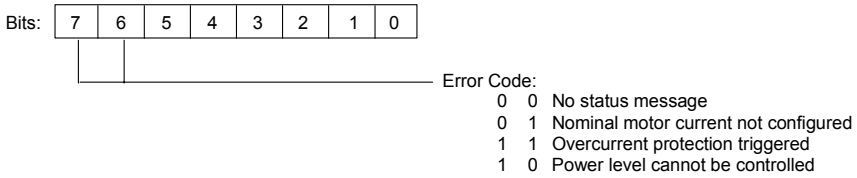
Monitoring the Motor's On/Off State (input bit 5)

Bit 5 of the input byte shows whether the motor is currently running.



Reading Status and Error Messages

Bits 6 and 7 of the input byte contain status and error information.



During normal operation, the control system only needs to monitor bit 7. If bit 7 is 1, the control program can evaluate the entire diagnostic code and begin an appropriate response. The first error that occurred is indicated in the input data until it is removed and acknowledged by setting the Reset Acknowledgement bit (or by connecting a Motor Starter Pendent). The message is deleted once it has been acknowledged. Then the motor can be restarted.

If bit 7 is 0, the state of bit 6 indicates whether the nominal motor current has been configured. It is set at startup and following a restart, as mentioned below.

When an error occurs, the module sets input bit 7 to 1 and shuts down the motor immediately. The module's ERR LED lights.

The system should also monitor the motor control output bit(s), which are used to turn the motor on or off.

Bit 7	Bit 6	Description
Status (Informational) Message		
0	0	No status message
0	1	Nominal motor current not yet configured. This bit is set after the operating voltage U_L is switched on, and also after a restart (voltage reset). This message does NOT cause the motor to shut down, and does not need to be acknowledged.
Error Messages		
1	0	Power level cannot be controlled.
1	1	Overcurrent condition has triggered overcurrent protection.

Error Code 1 0 : Power Level Cannot be Controlled

The module generates error message 1 0 if either of the following conditions exists for more than 1 second:

- The control signal for the module is NOT present, but the measured motor current is greater than the minimum current.
- The control signal for the module is present, but the motor current is below the permissible minimum current for that module type. Note that for module IC220STR002, minimum current monitoring can be disabled as mentioned below and described earlier in this chapter.

The minimum current levels for the VersaPoint Motor Starter Modules are:

Module Type	Minimum Current
IC220STR001 IC220STR003	0.1 Amp
IC220STR002	0.16 Amp*
*For module IC220STR002 only, the system host can disable monitoring for minimum current level. If output bit 4 is set for this module, there is no minimum current level.	

If this error occurs, it can be acknowledged after 0.3 second.

Protecting the Motor

The motor does not shut down automatically under every circumstance that may cause the Motor Starter module to generate status code 1 0.

CAUTION

It is important to be able to switch off the 400V operating voltage of the Motor Starter Module if an error occurs, to prevent damage to the motor. An example shutdown system is shown in chapter 2.

These errors can be caused by defective power levels, the interruption of a phase in the main supply, or certain hardware faults. The application program can evaluate the error type and the present contents of the output control byte and make appropriate corrections.

Error Code 1 1 : Overcurrent

If the Motor Starter Module detects an overcurrent condition, it sets the bits 7 and 6 to 1 1 and turns off the motor. The ERR LED lights. An overcurrent error can only be acknowledged after a recovery time of at least 60 seconds.

Chapter 4

Local Motor Control

This chapter explains how to use Manual Mode for local control of the motor:

- Operation of the Motor Starter Module in Manual Mode
  - Enabling / Disabling Manual Mode
- Manual Mode Input Connections
  - Manual Mode Input Assignments
  - Manual Mode Input Diagrams
- Using a Motor Starter Pendent
  - Motor Protection Disabled with a Motor Starter Pendent
  - Controlling the Motor with a Motor Starter Pendent
  - Motor Starter Pendent Specifications
- Controlling Manual Mode from the System Host
  - Motor Protection Functions in System-Controlled Manual Mode

Operation of the Motor Starter Module in Manual Mode

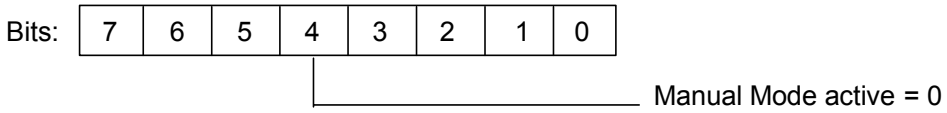
When Manual Mode is active, the motor must be controlled locally. The shutdown delay time is approximately 200ms.

If the system host has set up independent brake control using an optional Motor Starter Brake Module, the brake is automatically controlled by the manual motor input(s). Independent brake control is restored on exiting Manual Mode.

Enabling / Disabling Manual Mode

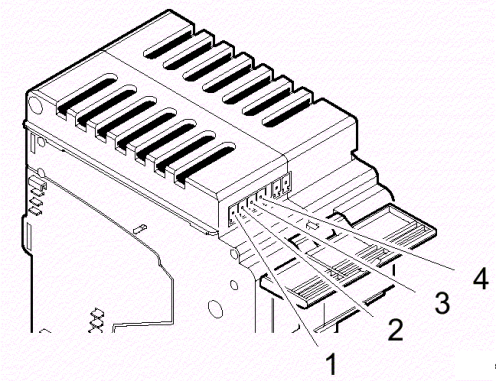
When Manual Mode is being enabled or disabled, there is a delay time of 1 second. During this time, the Motor Starter Module switches the motor off. If a brake switch is connected, it opens.

When switched to Manual Mode, the module immediately indicates Manual Mode operation in its input data byte:

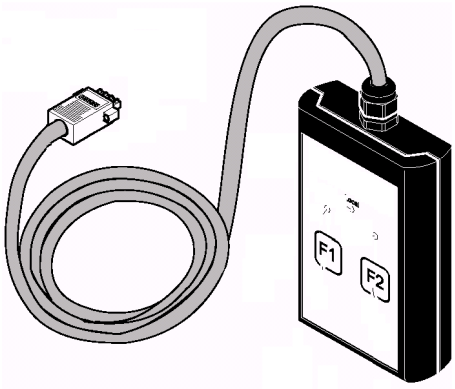


Manual Mode Input Connections

Connections for Manual Mode are made to the upper left corner of the Motor Starter Module.



Typically, this connector is used to attach a Motor Starter Pendent (IC220STR002).



Manual Mode Input Assignments

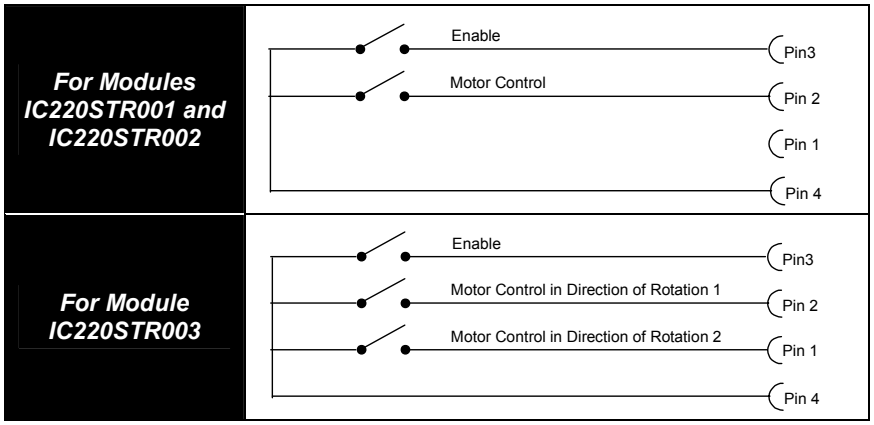
The module's connector pins for Manual Mode have the following assignments:

Pin	Function	For Modules IC220STR001 and IC220STR002	For Module IC220STR003
1	Input E9	Not used	Motor on/off, direction of rotation 1
2	Input E8	Motor on/off	Motor on/off, direction of rotation 2
3	Input E10	Enable Manual Mode	
4	U_S	24V segment voltage	

The 24V segment voltage (pin 4) is not protected against short-circuit or overloads inside the module. The installation should include short-circuit protection for the segment voltage at the VersaPoint Power Terminal or Segment Terminal module that supplies the 24V segment voltage for the Motor Starter Module.

Manual Mode Input Diagrams

A Motor Starter Pendent or similar switching device connects to the module inputs as indicated below. It is also possible to control the motor inputs by connecting a switching device to the motor control input(s) only and controlling the Enable signal from the system host.

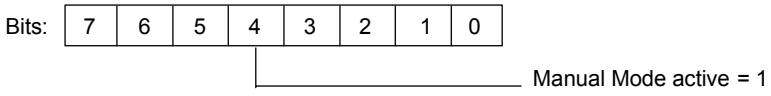


If a Motor Starter Pendent or other switching device that controls the Enable input is used, the motor protection functions of the Motor Starter Module are NOT available. However, if the system host controls the Enable input and an external device controls only the Motor Control input(s), the motor protection functions of the module ARE available.

Using a Motor Starter Pendent

Connecting the Motor Starter Pendent (or similar device) to the module's Enable input and Motor Control input(s) automatically enables Manual Mode. When Manual Mode is enabled, the Local LED on the Motor Starter Pendent lights and the LOC LED on the Motor Starter Module lights.

After Manual Mode has been activated, the Motor Starter Module automatically indicates that it is in Manual Mode in its input data:



Note that the Motor Starter Pendent cannot be used with two Motor Starter Modules IC220STR002 that are connected in a reversing application.

Motor Protection Disabled with a Motor Starter Pendent

When the module's Enable input is connected via a Motor Starter Pendent or similar switching device, the motor protection functions of the module (overcurrent, maximum current) are NOT available.

This differs from an installation where the system host enables and disables Manual Mode, and only the Motor Control input(s) are switched manually. When the system host controls the Enable function, motor protection functions ARE available. Control of Manual Mode by the system host is described later in this chapter.

Switching to Manual Mode when Errors are Present

Switching to Manual Mode acts as an error acknowledgement that is equivalent to a Reset Acknowledgement command. If Manual Mode is set while an error is present, that error no longer appears in the module's input data. However, if the error condition still exists upon exiting Manual Mode, it is again reported in the input data.

If Manual Mode is entered during the 60-second waiting time following an overcurrent error, the 60-second wait starts again when exiting Manual Mode. The overcurrent error cannot be acknowledged during this time.

Errors During Manual Mode

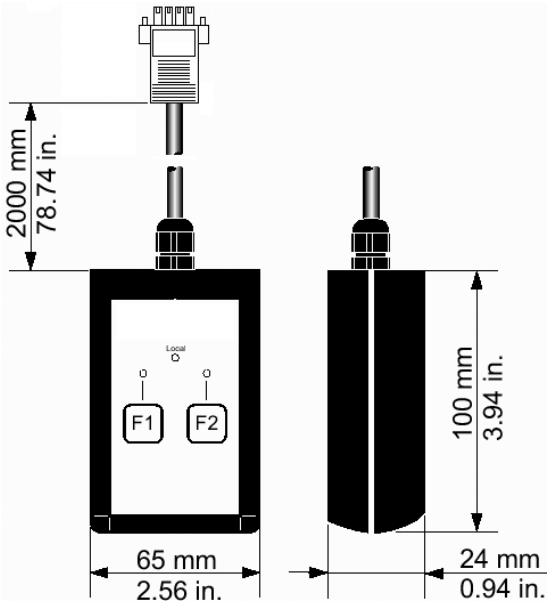
If an error occurs while the Motor Starter Module is in Manual Mode, the error is not reported in the input data byte. When Manual Mode is exited, errors are no longer displayed if the cause has been removed. Any errors that are still present are displayed again.

Controlling the Motor with a Motor Starter Pendent

The Motor Starter Pendent has two function buttons, F1 and F2, each with its own LED.

Button	For Modules IC220STR001 and IC220STR002	For Module IC220STR003
F1	Motor on/off	Motor on/off, direction of rotation 1
F2	Not used	Motor on/off, direction of rotation 2

Motor Starter Pendent Specifications

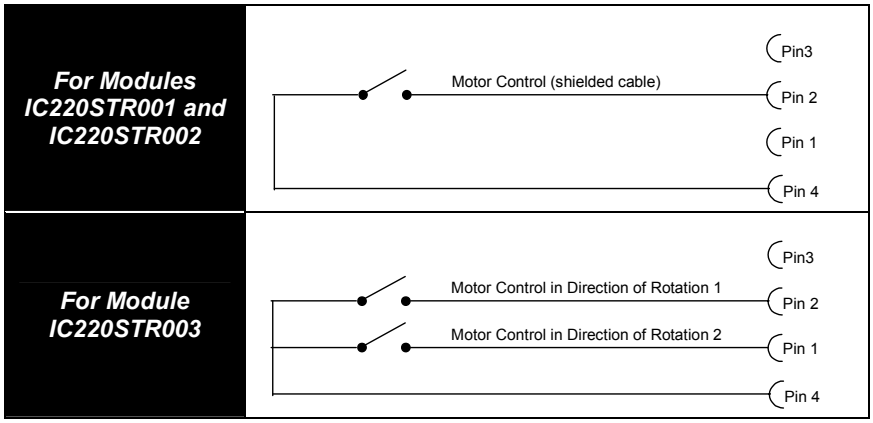


Motor Starter Pendent	
Voltage	24VDC nominal, 32VDC maximum
Operating temperature	-40 deg. C (-40 deg. F) to +60 deg. C (140 deg F)
Storage temperature	-20 deg. C (-4 deg. F) to +60 deg. C (140 deg F)
LEDs	Local, F1, F2

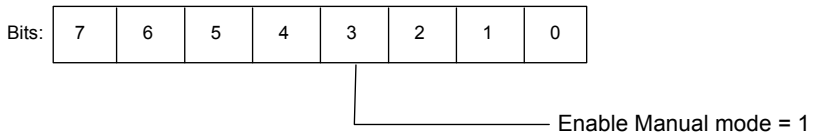
Controlling Manual Mode from the System Host

The Motor Starter Module's Motor Control input(s) are not used unless Manual Mode is also enabled. A Motor Starter Pendent or similar switching device controls Manual Mode by connecting to both the Enable input and the Motor Control input(s).

It is also possible to control Manual Mode by connecting only the Motor Control input(s) as shown below. A shielded cable must be used for the Motor Control inputs to minimize potential effects from interference.



Because the Enable input is not controlled by the switching device, Manual Mode must be enabled or disabled from the system host by setting bit 3 of the module's output data word:



Motor Protection Functions in System-Controlled Manual Mode

When the system host enables and disables Manual Mode as described above, the motor protection functions of the Motor Starter Module (overcurrent, maximum current) remain available. This differs from the other Manual Mode options. When the module's Enable input is connected via a Motor Starter Pendent or similar switching device, the motor protection functions of the module are NOT available.

Chapter 5 Motor Starter Brake Modules

This chapter describes the use of an optional Motor Starter Brake Module:

- Description of the Brake Modules
  - Motor Starter Brake Module Features
  - Internal Circuit Diagram of a Brake Module
- System Host Controls the Operation of the Brake
  - Enabling Brake Control
  - Switching the Brake
- Specifications for the Motor Starter Brake modules

Description of the Brake Modules

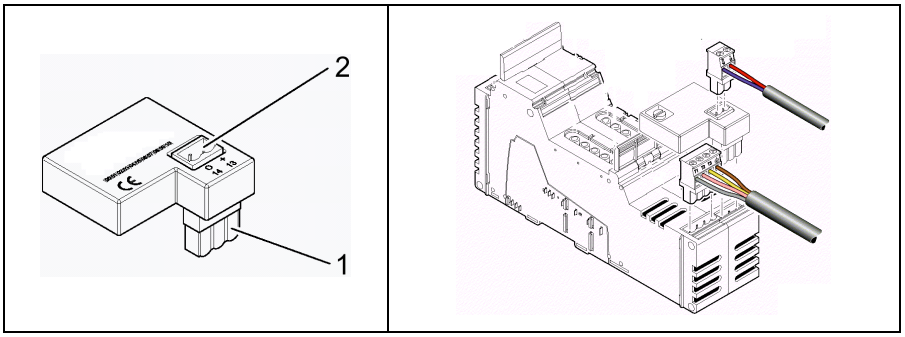
A Motor Starter Brake module is a passive electronic brake switch that can be used to connect a brake to a VersaPoint Motor Starter module.

Two VersaPoint Motor Starter Brake modules are available: IC220ACC100 and IC220ACC101. Both types can be used with any VersaPoint Motor Starter Module.

Motor Starter Brake Module Features

- Electronic brake switch (solid-state switch)
- Nominal voltage ranges:
  - IC220ACC100: from 12VDC to 400VDC, 20VAC to 400VAC
  - IC220ACC101: from 5VDC to 31VDC
- Protection against polarity reversal

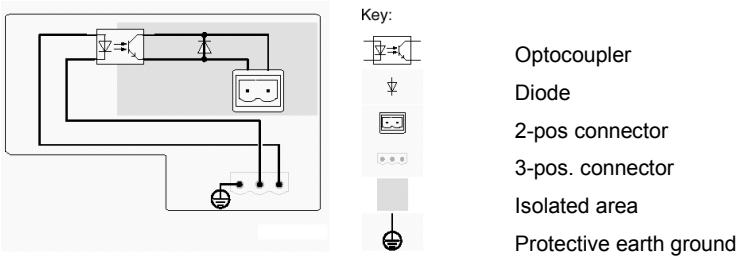
Brake Module Connections



Connector 1 (above) on the brake module connects to the Motor Starter Module. Connector 2 is for the brake. The brake must be connected with the correct polarity or it will not operate properly.

During operation, the brake module switches a rectified voltage from the brake rectifier of the motor to the brake.

Internal Circuit Diagram of a Brake Module



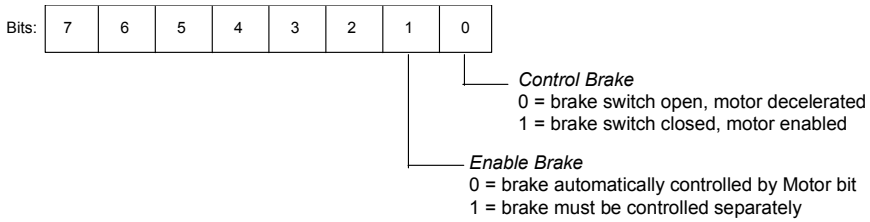
Controlling the Operation of the Brake

Ordinarily, the Motor Starter Module controls the operation of the brake automatically, based on the motor control commands it receives from the system host. When the Motor Starter Module is being controlled by a Motor Starter Pendent or similar switching device, or if the Reset Acknowledge bit (5) is set, the module always controls the brake automatically.

When the host is controlling module operation, the host can enable independent control of the brake as described below.

Enabling Brake Control

Independent brake operation is enabled or disabled using the Enable Brake command (output bit 1).



- When the Enable Brake bit (1) is set to 0, the brake cannot be freely controlled; it is automatically controlled by the bit(s) controlling the motor.
- If the Enable Brake bit (1) is set to 1, the brake must be explicitly controlled using bit 0, even if an error occurs.
  - When the Brake bit (0) is set to 0, the brake switch is opened, the brake takes effect, and the motor is decelerated.
  - When the Brake bit (0) is set to 1, the brake switch is closed, the brake is released, and the motor is enabled.
- If the Enable Brake bit (1) is reset to 0 after being set to 1, the brake is set according to the present state of the motor. If the motor is on, the brake is released. If the motor is off, the brake is enabled.

Specifications for Motor Starter Brake Modules: IC220ACC100 and IC220ACC101

General Data	
Housing dimensions (width x height x depth)	57mm x 55mm x 16mm (2.24in x 2.17in x 0.63in)
Ambient temperature (operation)	-25°C to +55°C (-13°F to +131°F)
Ambient temperature (storage/transport)	-25°C to +85°C (-13°F to +185°F)
Humidity	75% on average; 85% occasionally; (no condensation)
Degree of protection	IP 20 according to IEC 60529
Class of protection	Class 1 according to EN 51078

Motor Starter Brake Module	
Control voltage	24VDC from the Motor Starter Module
Control current	17mA
Current limit	Using dropping resistor

Brake to be Connected	
Contact spacing	7.62mm (0.30 in)
Cable diameter	Up to 2.5mm^2 (14 AWG)
Maximum continuous current	300mA
Protective current	IC220ACC100: Diode against polarity protection and TAZ diode
	IC220ACC101: Diode against polarity protection and 460V varistor
Degree or protection	Protection against direct touch
Contact type	Polarized solid-state contact
Connection voltage (no tolerances permitted)	IC220ACC100: 5VDC minimum to 31VDC maximum
	IC220ACC101: 12VDC minimum to 440VDC maximum, 20VAC minimum to 400VAC maximum
Residual voltage	IC220ACC100: 0.4VDC maximum
	IC220ACC101: 3.4VDC maximum

Power Dissipation
Power dissipation of the electronics can be calculated using the following formulas: For IC220ACC100: P_{TOT}= 0.1 W + (0.4 V x I_L) For IC220ACC101: P_{TOT}= 0.1 W + (3.4 V x I_L) P_{TOT} is the total power dissipation of the brake module I_L is the load current

Safety Devices	
Overvoltage	IC220ACC100: TAZ diode IC220ACC101: 460V varistor
Polarity reversal of the brake	Diode against polarity protection

Electrical Isolation / Isolation of the Voltage Range	
CAUTION: To provide electrical isolation between the logic level and the I/O area, you must supply the VersaMax I/O Station NIU and the brake module using separate power supplies. Do not interconnect the 24V power supplies.	
Common potentials: the 24V segment voltage, GND, and brake control have the same potential. The protective earth ground PE and the brake each have their own isolated area.	
Isolated Voltages in the System Consisting of a Motor Starter Module, Brake Module and Brake	
24V supply US , GND, brake control / protective earth ground (PE)	500 VAC, 50 Hz, 1 min
For Brake Module IC220ACC100:	
24V supply US , GND, brake control / brake output	500 VAC, 50 Hz, 1 min
Brake output / protective earth ground (PE)	500 VAC, 50 Hz, 1 min
For Brake Module IC220ACC101:	
24V supply US , GND, brake control / brake output	1200 VAC, 50 Hz, 1 min
Brake output / protective earth ground (PE)	1200 VAC, 50 Hz, 1 min

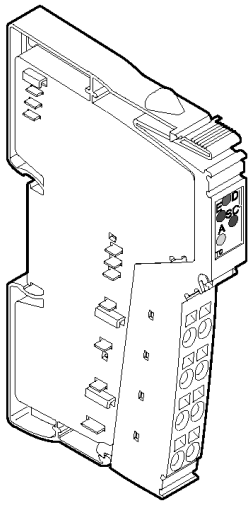
Chapter 6 Motor Protection with a Thermistor Module

This chapter describes the use of an optional VersaPoint Thermistor Module to provide thermal protection for motors with built-in thermistors:

- Description of the Thermistor Module
  - Thermistor Module Features
- Thermistor Module Operation
  - System Host Shuts Down the Motor
  - Thermistor Module Switching Output Shuts Down the Motor
- Thermistor Module Connections
  - Connecting the Thermistor Module to the Motor Starter Module
  - Controlling the Motor without Using the Motor Starter Module
- Internal Circuit Diagram of the Thermistor Module
- Thermistor Module LEDs
- Specifications for the Thermistor Module

Description of the Thermistor Module

Motors with integrated thermistors can be thermally-protected with an optional VersaPoint Thermistor Module (IC220MDD850).



Thermistor Module Features

The Thermistor Module monitors motor thermistors for:

- Operating range (resistance between 50 Ohms and 2.25kOhms)
- Tripping range (resistance of 4k Ohms or more)
- Motor temperature below the tripping temperature (generates warning)
- Short-circuit (resistance is 50 Ohms or less)

It also evaluates the optional PTC resistors incorporated in three-phase induction motors

Thermistor Module Operation

If an error occurs, the Thermistor Module can cause the Motor Starter Module to shut down the motor in either of two ways:

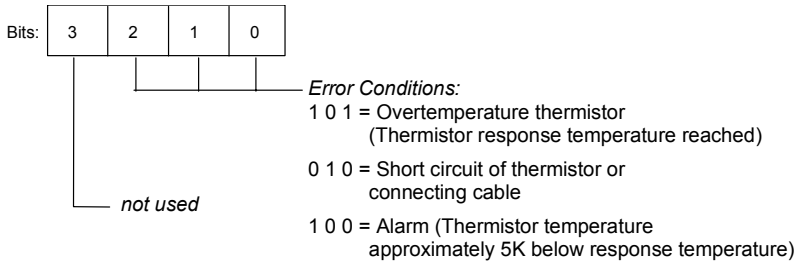
- by triggering a command from the system host to the Motor Starter Module.
- by using its switching output to control the 24V segment voltage to the Motor Starter Module.

System Host Shuts Down the Motor

When the system host controls thermistor protection, it monitors the input data sent by the Thermistor Module. If an error occurs, the application program can command the Motor Starter Module to shut down the motor.

Input Data Sent by the Thermistor Module

The Thermistor Module sends 4 bits of input data to the system host. It does not have any output data. The group of 4 bits can be in any position within the byte.



If an overtemperature error occurs, the Thermistor Module sets bit 0 of its input data to 1. At the same time, the Thermistor module turns OFF its switching output.

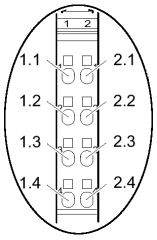
Note that the Thermistor Module sees motors with thermostatic switches as short circuits.

Thermistor Module Switching Output Shuts Down the Motor

The switching output of the Thermistor Module can be directly connected to the Motor Starter Module as shown on the next page. If thermistor resistance is 4k Ohms or more, the Thermistor Module turns off its switching output. That, in turn, interrupts the 24V power to the Motor Starter Module. The Motor Starter Module then turns off the motor.

Thermistor Module Connections

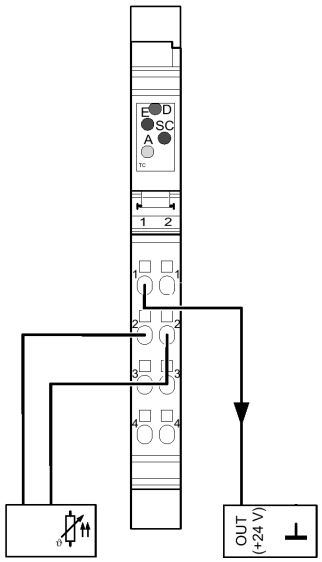
Thermistor Module IC220MDD850 requires one (1) I/O Terminal Strip, IC220TBK081, ordered separately. The pin assignments are:



Terminal Point	Assignment
1.1	Switching output
2.1	Ground for Switching Output
1.2, 2.2	Thermistor Connection
1.3, 2.3	not used
1.4, 2.4	Functional Earth Ground

Connecting the Thermistor Module to the Motor Starter Module

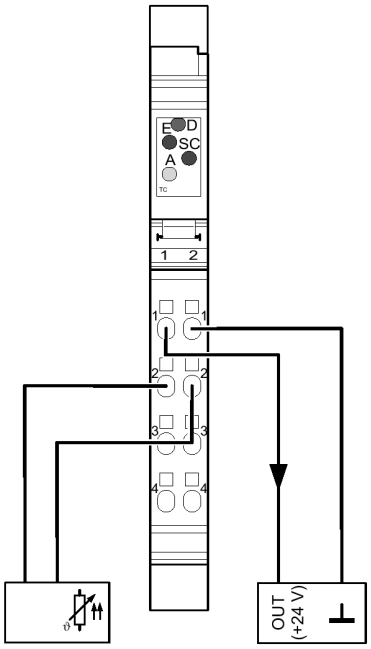
If the Thermistor Module's switching output is used to control the Motor Starter Module, then point 1.1 on the Thermistor Module should be connected to the 24V Enable Input at the upper left of the Motor Starter Module, as described in chapter 2. The switching output ground (pin 2.1) may not be connected because it is internally connected via the voltage jumper.



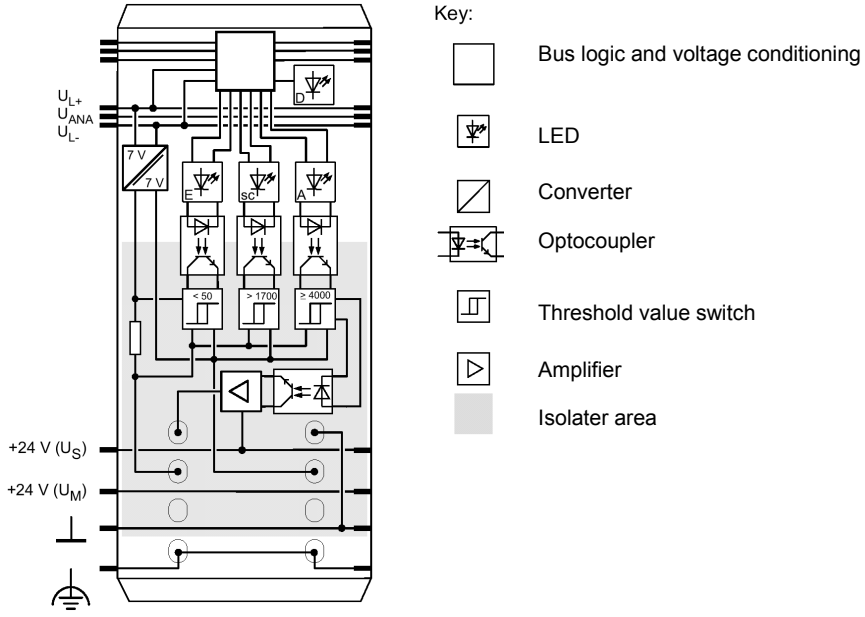
Controlling the Motor without Using the Motor Starter Module

A Thermistor Module can also provide thermal protection for a motor without using the Motor Starter Module, to turn off the motor in case of error. This type of installation requires an extra VersaPoint power terminal that supplies power to a VersaPoint discrete output module. The discrete output module controls the operation of the motor.

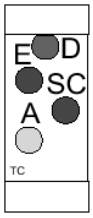
The Thermistor Module is connected to the thermistor and to the power terminal. If the switching output on the Thermistor module becomes inactive, power is no longer supplied to the power terminal and the motor is switched off. This type of installation is wired as shown below.



Internal Circuit Diagram of the Thermistor Module



Thermistor Module LEDS



LED	Color	Meaning
D	Green	Bus diagnostics
E	Red	Error (overtemperature thermistor)
SC	Red	Short circuit of the thermistor or connecting cable
A	Yellow	Alarm message (thermistor temperature is approximately 5K below response temperature)

Specifications for the Thermistor Module: IC220MDD850

General Data	
Housing dimensions (width x height x depth)	12.2mm x 120mm x 71.5mm (0.48in x 4.72in x 2.82in)
Ambient temperature (operation)	-25°C to +55°C (-13°F to +131°F)
Ambient temperature (storage/transport)	-25°C to +85°C (-13°F to +185°F)
Humidity	75% on average; 85% occasionally; (no condensation)
Degree of protection	IP 20 according to IEC 60529

Power Consumption	
Communications voltage	7.5V
Current consumption from the local bus	60mA, maximum
Power consumption from the local bus	0.45W
Segment supply voltage U_S	24VDC nominal
Nominal current consumption of U_S	0.5A maximum
Total power consumption	0.15W maximum

Thermistor Input	
Number	1
Connection type	2-wire
Thermistor current	1.2A maximum
No-load voltage	Under 8VDC
Filter time	10ms typical
Cable length to thermistor	30 meters (95 ft) maximum

Switching Thresholds	
Operating range (total resistance)	50 Ohms to 2.25k Ohms
Tripping range (total resistance)	4k Ohms or more
Tripping value (total resistance)	2.7k Ohms to 3.5k Ohms
Release value	1.4k Ohms to 1.5k Ohms
Warning (response temperature minus 5 K)	1.6k Ohms to 1.8k Ohms
Short circuit	Under 50 Ohms

Switching Output	
Output signal high	Total resistance less than 2.7k Ohms
Output signal low	Total resistance more than 3.5k Ohms
Output voltage	Segment voltage - 1V
Output current	50mA, short-circuit-proof

Power Dissipation
Power dissipation of the electronics can be calculated using the following formula: $P_{EL} = 0.45\ W + (3\ V \times I_L)$ P_{TOT} is the total power dissipation of the module I_L is the load current
Power dissipation of the housing is 0.6W

Safety Devices	
Overvoltage	Protective circuits of the power terminal
Polarity reversal	Protective circuits of the power terminal
Overload in segment circuit	Yes, thermal protection

Electrical Isolation / Isolation of the Voltage Range	
CAUTION: To provide electrical isolation between the logic level and the I/O area, you must supply the VersaMax I/O Station NIU and the thermistor module using separate power supplies. Do not interconnect the 24V power supplies. The connection terminals of the thermistor are isolated to the 7.5V supply, the 24V supply, and the functional earth ground with a basic insulation for a 300VAC rated voltage.	
Common potentials: the 24V segment voltage, and GND have the same potential. Functional earth ground is a separate potential area.	
Separate System Potentials Consisting of NIU / Power Terminal and I/O Terminal	
5V supply incoming remote bus / 7.5V supply (bus logic)	500 VAC, 50 Hz, 1 min
5V supply outgoing remote bus / 7.5V supply (bus logic)	500 VAC, 50 Hz, 1 min
7.5V supply (bus logic) / 24V supply (I/O)	500 VAC, 50 Hz, 1 min
24V supply (I/O) / functional earth ground	500 VAC, 50 Hz, 1 min
Thermistor / all other areas	1200 VAC, 50 Hz, 1 min

Programming Data	
ID code	BE_{hex} (190_{dec})
Length code	41_{hex}
Input length	4 bits
Output length	0
Parameter channel	0 bits
Register length	4 bits

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